

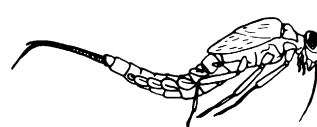
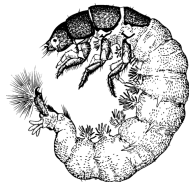
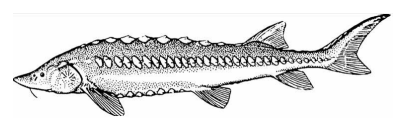
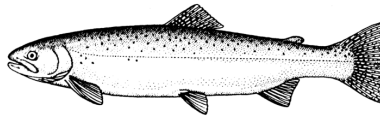
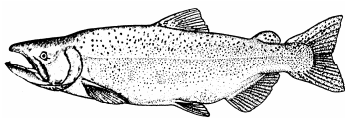
**IDENTIFICATION OF THE INSTREAM FLOW REQUIREMENTS FOR
ANADROMOUS FISH IN THE STREAMS WITHIN THE CENTRAL VALLEY
OF CALIFORNIA AND FISHERIES INVESTIGATIONS**

**Annual Progress Report
Fiscal Year 2015**

U.S. Fish and Wildlife Service
Lodi Fish and Wildlife Office
850 S. Guild Avenue, Suite 105
Lodi, California 95240



Prepared by staff of
The Anadromous Fish Restoration Program



PREFACE

The following is the Fourteenth Annual Progress Report, Identification of the Instream Flow Requirements for Anadromous Fish in the Streams within the Central Valley of California and Fisheries Investigations, prepared as part of the Central Valley Project Improvement Act (CVPIA) Instream Flow and Fisheries Investigations, an effort which began in October, 2001.¹ Title 34, Section 3406(b)(1)(B) of the CVPIA, P.L. 102-575, requires the Secretary of the Department of the Interior to determine instream flow needs for anadromous fish for all Central Valley Project controlled streams and rivers, based on recommendations of the U.S. Fish and Wildlife Service (Service) after consultation with the California Department of Fish and Wildlife (CDFW). The purposes of this investigation are: 1) to provide scientific information to the Service's CVPIA Program to be used to develop such recommendations for Central Valley streams and rivers; and 2) to provide scientific information to other CVPIA programs to use in assessing fisheries restoration actions. The purpose of this report is to provide an update on the Anadromous Fish Restoration Program's CVPIA-funded activities and accomplishments during fiscal year 2015 to interested stakeholders. An in-depth presentation on the instream flow studies is given in the final reports for these studies. The annual reports serve as final reports for the fisheries investigation tasks.

The field work described herein was conducted by Mark Gard, Rick Williams, John Henderson, Tricia Parker-Hamelberg, Steve Thomas, Beth Lawson, April McEwan, Josh Gruber and Tanya Sheya.

Written comments or questions can be submitted to:

Mark Gard, Senior Biologist
Anadromous Fish Restoration Program
U.S. Fish and Wildlife Service
Lodi Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

Mark_Gard@fws.gov

Electronic versions of our final reports and previous years' annual reports are available on our website:

http://www.fws.gov/sacramento/Fisheries/Instream-Flow/fisheries_instream-flow_reports.htm

¹ The scope of this program was broadened in FY 2009 to include fisheries investigations. This program is a continuation of a 7-year effort, titled the Central Valley Project Improvement Act Instream Flow Investigations, which ran from February 1995 through September 2001. This is the last report for this program.

OVERVIEW

In response to substantial declines in anadromous fish populations, the Central Valley Project Improvement Act provided for enactment of all reasonable efforts to double sustainable natural production of anadromous fish stocks including the four races of Chinook salmon (fall, late-fall, winter, and spring), steelhead trout, white and green sturgeon, American shad and striped bass. Between 2001 and 2013, the Service's Sacramento Fish and Wildlife Office, Energy Planning and Instream Flow Branch completed instream flow study reports on the Sacramento, Lower American, Yuba, Stanislaus and Tuolumne Rivers and Butte, South Cow and Clear Creeks. For Clear Creek, we worked with the USFWS Red Bluff staff in FY 2015 to issue a final report that provides a synthesis of our four instream flow study reports. The final synthesis report was issued on January 28, 2015.

In 2015, the following fisheries investigation tasks were selected for study: 1) Feather River Sunset Pumps pre-restoration assessment; 2) Feather River Garden Highway Mutual Water Company screen data collection; 3) Clear Creek redd dewatering analysis; 4) Merced River floodplain area versus flow; 5) South Fork Cottonwood Creek (Tehama County) Hammer Dam post-restoration monitoring; 6) Antelope Creek Lower Slab passage assessment; 7) Sacramento River juvenile green sturgeon habitat data collection; and 8) Central Valley Structured Decision Model technical support.

We performed the following fisheries investigations to assess fisheries restoration actions:

- 1) In FY 2015, we collected data to build a hydraulic model of the Sunset Pumps weir on the Feather River.
- 2) We collected topographic and hydraulic data to use in a feasibility report for the proposed Garden Highway Mutual Water Company fish screen project, with funding from the Anadromous Fish Screen Program.
- 3) We conducted a redd dewatering analysis, with funding from the Clear Creek Program.
- 4) We collected additional topographic data and started developing hydraulic models to create a Merced River floodplain area versus flow relationship, with funding from the Federal Energy Regulatory Commission Program. Further work on this task is dependent on the availability of funding in FY 2016.
- 5) We conducted post-project monitoring of the Hammer Dam removal restoration project.
- 6) We completed a hydraulic model at the Antelope Creek Lower Slab to assess at what flows this structure is a barrier to upstream passage of adult spring-run Chinook salmon. In FY 2016, we will be using this model to develop a solution to the upstream passage barrier at this location.
- 7) We collected topographic and hydraulic data for portions of the Sacramento River where juvenile green sturgeon have been detected.
- 8) We reviewed the Central Valley Structured Decision Model to identify needed changes to the model and sources of data that could be used to improve the parameterization of the model, with funding from the Comprehensive Assessment and Monitoring Program.

The results of these scientific investigations were provided to other CVPIA programs. The following sections summarize the eight project activities that were performed between October 2014 and September 2015.

FISHERIES INVESTIGATIONS

Feather River Sunset Pumps Upstream Passage Assessment

Methods

The purpose of this task was to develop a hydraulic model of the Feather River at the Sunset Pumps weir near Live Oak, California to assess upstream passage of spring-run Chinook salmon and sturgeon over a range of flows. Based on data from the California Department of Water Resources (CDWR), the 10-foot tall Sunset Pumps boulder weir (Figure 1) is a barrier to upstream passage of green sturgeon for Feather River flows less than 6,000 cfs. The topography data collected to develop the hydraulic model will also be useful in designing any potential restoration projects to solve the upstream passage barrier at this location.



Figure 1
Sunset Pumps weir

We installed a pressure transducer at the downstream end of the 3400-foot-long study site to develop the downstream boundary conditions for the hydraulic model. We measured water surface elevations (WSELs) at the upstream end of the site at a flow of 3,877 cfs to calibrate the hydraulic model. Topographic data between the upstream (1500 feet above the weir) and downstream (1900 feet below the weir) boundaries of the site were collected using survey-grade Real Time Kinematic Global Positioning System (RTK GPS) units for the dry and shallow portions of the sites, and with a combination of an Acoustic Doppler Current Profiler (ADCP) and a survey-grade RTK GPS unit for the deeper portions. For each traverse with the ADCP, the RTK GPS was used to record the horizontal location and WSEL at the starting and ending location of each traverse, while the ADCP provided depths and distances across the traverse. The WSEL of each ADCP traverse is then used together with the depths from the ADCP to determine the bed elevation of each point along the traverse. We also collected substrate and cover data (Tables 1 and 2) for each topographic point collected with the survey-grade RTK GPS

Table 1
Substrate Descriptors and Codes

Code	Type	Particle Size (inches)
0.1	Sand/Silt	< 0.1
1	Small Gravel	0.1 – 1
1.2	Medium Gravel	1 – 2
1.3	Medium/Large Gravel	1 – 3
2.3	Large Gravel	2 – 3
2.4	Gravel/Cobble	2 – 4
3.4	Small Cobble	3 – 4
3.5	Small Cobble	3 – 5
4.6	Medium Cobble	4 – 6
6.8	Large Cobble	6 – 8
8	Large Cobble	8 – 10
9	Boulder/Bedrock	> 12
10	Large Cobble	10 – 12

unit. Substrate and cover data for the deeper (greater than 3 feet deep) portions of the site were mapped using a Humminbird® 1198C Side Imaging (SI) system and methodology outlined in Kaesar and Litts (2010). Sonar snapshots were recorded at 30 second intervals to collect consecutive overlapping images. The sonar transducer was mounted off the starboard bow of a 21 foot inboard jet boat and frequency was set at 455 kHz during sonar surveys. The side beam range was range varied from 100 ft (30.48 m) to 200 ft (60.96 m), per side, during the surveys to capture a bank full scan of the river substrate. When necessary a second transect was conducted to cover the entire sampling area. An external antenna mounted off the boat canopy was used to track the boat's course at five second intervals for image capture locations, at a stated accuracy of 3–5 meters. User settings were adjusted to “offset” the distance between the transducer and GPS antenna.

LIDAR data collected by CDWR was used as the data source for the topography of most of the dry portion of the site. Aerial imagery was used with head-up digitizing to map substrate and cover polygons for the dry portions of the site, which were then used to map substrate and cover codes onto the LIDAR data. SONAR data collected by Cramer Fish Sciences in the summer of 2011 at a flow of 6,567 cfs was used as an additional data source for topography of the deeper

Table 2
Cover Coding System

Cover Category	Cover Code
No cover	0.1
Cobble	1
Boulder	2
Fine woody vegetation (< 1" diameter)	3
Fine woody vegetation + overhead	3.7
Branches	4
Branches + overhead	4.7
Log (> 1' diameter)	5
Log + overhead	5.7
Overhead cover (> 2' above substrate)	7
Undercut bank	8
Aquatic vegetation	9
Aquatic vegetation + overhead	9.7
Rip-rap	10

(greater than 3 feet deep) areas of the site. We calculated the water surface elevation when the SONAR data was collected by the difference in depths of triangular irregular networks (TINs) for the SONAR data and our deep topography data, for the area sampled by both groups. The difference in depth was added to the water surface elevation during our sampling to calculate the water surface elevation at 6,567 cfs. The depths from the SONAR data were subtracted from this water surface elevation to determine the bed elevations of the SONAR data.

Side-scan sonar imagery geoprocessing used for this project was completed using methods detailed within Kaeser and Litts, *Sonar Imagery Geoprocessing Workbook* (version 2.1; 2011). Environmental Systems Research Institute's (ESRI) GIS software and the IrfanView graphic viewer was used to transform raw sonar images into sonar image maps (SIMs) with real world coordinates (e.g., Universal Transverse Mercator [UTM]). ArcMap and IrfanView was used remove the image collar, crop overlapping sections on consecutive snapshots, and the generation of raw SIMs. The resultant mosaics consist of 3-11 individual images, each representing

approximately a 200 to 650 meter stream reach. SIMs were then saved as new data layer to be heads up digitized based on the texture to create substrate and cover polygons, which were used to map substrate and cover codes on to the ADCP and SONAR topography data.

The topographic data for the 2-D model (contained in bed files) is first processed using the R2D_Bed software, where breaklines are added to produce a smooth bed topography. The resulting data set is then converted into a computational mesh using the R2D_Mesh software, with mesh elements sized to reduce the error in bed elevations resulting from the mesh-generating process to 0.1 foot where possible, given the computational constraints on the number of nodes. The resulting mesh is used in River2D to simulate depths and velocities at the flows to be simulated. The initial bed roughnesses used by River2D are based on the observed substrate sizes and cover types, using the conversions in Table 3. A multiplier is applied to the resulting bed roughnesses, with the value of the multiplier adjusted so that the WSEL generated by River2D at the inflow end of the site match the WSEL measured at the inflow end of the site². The River2D model is run at the simulation flows to use in assessing upstream passage.

Results

In FY 2015, we completed collection of the topographic data and started developing the bed file for the Sunset Pumps site. We collected a total of 6,947 topography points between the RTK GPS and ADCD data, and, adding in the LIDAR and SONAR data, had a total of 25,275 data points to use in developing the bed file. In FY 2016, we will complete the bed file, develop the mesh file and complete hydraulic simulations of the site.

Garden Highway Mutual Water Company Fish Screen Project Data Collection

Methods

We used the methods described above for the Sunset Pumps project to collect topography, depth and velocity data in the vicinity of the Garden Highway Mutual Water Company's Feather River Pump Station. The data were provided to the consulting firm HDR to use in developing alternatives for a fish screen at this location.

Results

We collected 7,580 topography, depth and velocity measurements. These data (Figures 2 and 3) were used to assess six fish screen and intake alternatives (see HDR 2015).

² This is the primary technique used to calibrate the River2D model.

Table 3
Initial bed roughness values

Substrate Code	Bed Roughness (m)	Cover Code	Bed Roughness (m)
0.1	0.05	0.1	0
1	0.1	1	0
1.2	0.2	2	0
1.3	0.25	3	0.11
2.3	0.3	3.7	0.2
2.4	0.4	4	0.62
3.4	0.45	4.7	0.96
3.5	0.5	5	1.93
4.6	0.65	5.7	2.59
6.8	0.9	7	0.28
8	1.25	8	2.97
9	0.05, 0.76, 2 ³	9	0.29
10	1.4	9.7	0.57
		10	3.05

Discussion

Cross-section topography data in the inlet channel to the existing pump had a minimum cross-sectional area of 191 ft², which would result in an average velocity of 0.52 ft/s at the maximum pumping rate of 100 cfs. Consequently, any alternative with a fish screen located at the pump would require expansion of the inlet channel to meet NMFS criteria. See HDR (2015) for additional discussion.

³ For substrate code 9, we used bed roughnesses of 0.76 and 2, respectively, for cover codes 1 and 2, and a bed roughness of 0.05 for all other cover codes. The bed roughness value for cover code 1 (cobble) was estimated as five times the assumed average size of cobble (6 inches [0.15 m]). The bed roughness values for cover code 2 (boulder) was estimated as five times the assumed median size of boulders (1.3 feet [0.4 m]). Bed roughnesses of zero were used for cover codes 1 and 2 for all other substrate codes, since the roughness associated with the cover was included in the substrate roughness.

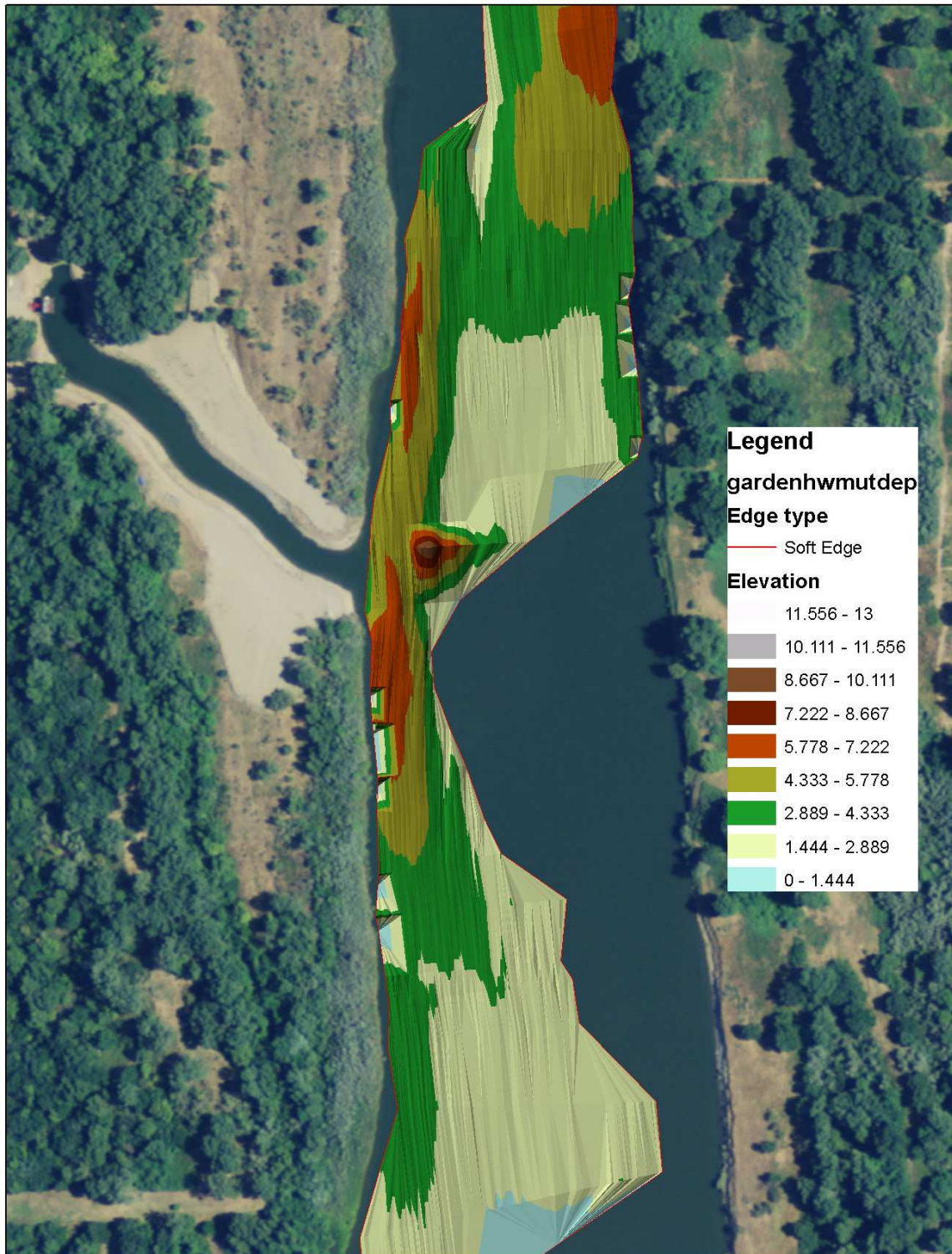


Figure 2
Depths at Garden Highway Mutual Water Company screen site

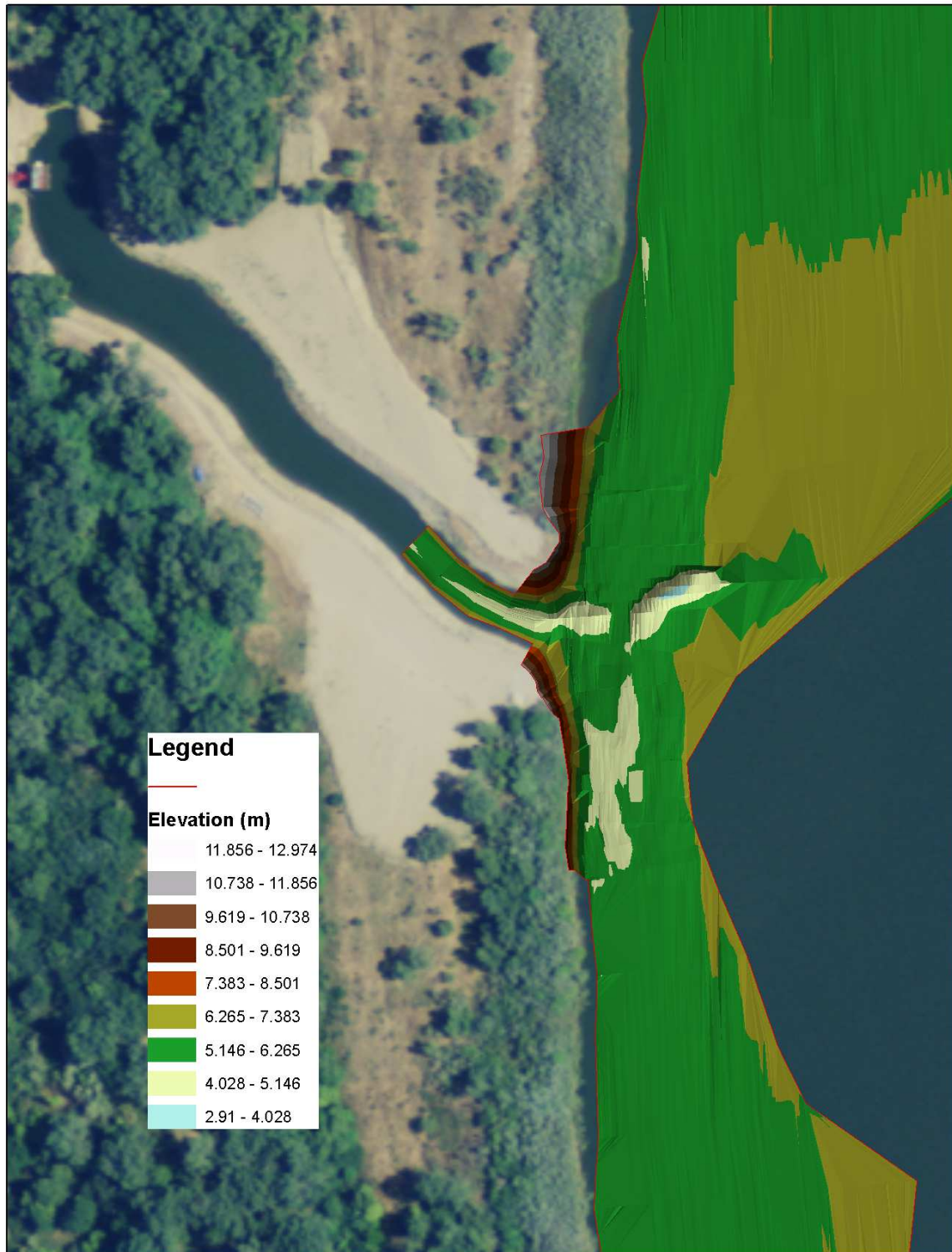


Figure 3
Topography at Garden Highway Mutual Water Company screen site

Clear Creek Redd Dewatering

Methods

The purpose of this task was to quantify the percentage of fall-run redds in Clear Creek that would have been dewatered for dewatering flows ranging from 50 to 175 cfs. The Red Bluff Fish and Wildlife Office supplied us with spawning area mapping polygons for fall-run Chinook salmon in 2014 and 2015. From this data, we used the redds located in five two-dimensional hydraulic and habitat modeling sites on the lower alluvial segment of Clear Creek, that we had developed using hydraulic and structural data that we collected in 2006 to 2007. Since we had established these sites based on State Plane coordinates, we were able to convert the redd locations to local coordinates by just subtracting given numbers from the State Plane coordinates. For the spawning area mapping, we determined how many redds were in each mapped polygon by dividing the area of the polygon by 211 ft²/redd (U.S. Fish and Wildlife Service 2011) and then equally spaced points for that many redds in each polygon, using GIS⁴. We ran the hydraulic models for all five study sites at flows ranging from 50 to 175 cfs, and plugged in the surveyed redd locations to determine what the depth and velocity would have been at each redd location at those flows. Using the criteria of 0.5 feet and either 0.1 or 0.25 ft/s⁵, we then determined how many of the redd locations would have been dewatered at flows ranging from 50 to 175 cfs.

Results

The percentage of fall-run redds in Clear Creek in 2014 and 2015 that would have been dewatered ranged from less than 7 percent for a dewatering flow of 175 cfs to over 25 percent for a dewatering flow of 50 cfs (Table 4).

Discussion

The results of this analysis will provide CVPIA staff with the ability to predict the incremental impacts on egg and pre-emergent fry mortality of reducing Clear Creek flows during fall-run Chinook salmon redd incubation. Additional data collection and hydraulic modeling would be required to assess the relevance and usability of the instream data used in this analysis, given the changes to the creek post-restoration and the (nearly) annual injection of gravel.

⁴ 211 ft²/redd was the average area of single-redd fall-run Chinook salmon polygons in 2003 on Clear Creek.

⁵ A redd was considered dewatered if the depth was less than a depth of 0.5 feet or the velocity was less than a velocity of 0.1 or 0.25 ft/s. The depth criteria were based on the assumption that redds would be dewatered if the tailspills were exposed, while the velocity criteria were based on the assumption that there would be insufficient intragravel flow through the redd if the velocity was less than the lowest velocity at which we found a redd. See U.S. Fish and Wildlife Service (2006).

Table 4
Predicted percentages of Clear Creek fall-run Chinook salmon redds dewatered⁶

Year	Spawning Flow (cfs)	Dewatering Flow (cfs)	Percent Redds Dewatered
2013	215	175	5.6-6.3%
2013	215	150	8.6-9.7%
2013	215	125	11-12%
2013	215	100	16-19%
2013	215	75	21-29%
2013	215	50	30-37%
2014	185	175	5.8%
2014	185	150	8.7%
2014	185	125	12-14%
2014	185	100	13%
2014	185	75	19-20%
2014	185	50	25-27%

Merced River Floodplain Versus Flow Relationships

Methods

The goal of this task is to develop two-dimensional hydraulic models to quantify the relationship between floodplain area and flow for the following five reaches of the Merced River: 1) mouth of Merced River to Stevinson; 2) Stevinson to Cressy; 3) Cressy to Shaffer Bridge; 4) Shaffer Bridge to Snelling; and 5) Snelling to Crocker-Huffman (Figure 4), for flows ranging from 250 to 9,000 cfs. Topographic data were collected using the same methods described above for the Feather River Sunset Pumps project. In addition to the above data, Light Detection and Ranging (LIDAR) and bathymetry cross-section data collected by the California Department of Water Resources and National Marine Fisheries Service, as well as 1.2 miles of topography data collected for the Merced Ranch and Henderson Park restoration projects, will be used as the topographic data source for the hydraulic model. We installed pressure transducers near the mouth of the Merced River to use to develop the downstream boundary condition for the

⁶ The lower end of range is based on a dewatering velocity criterion of 0.1 ft/s, while the upper end of the range is based on a dewatering velocity criterion of 0.25 ft/s.

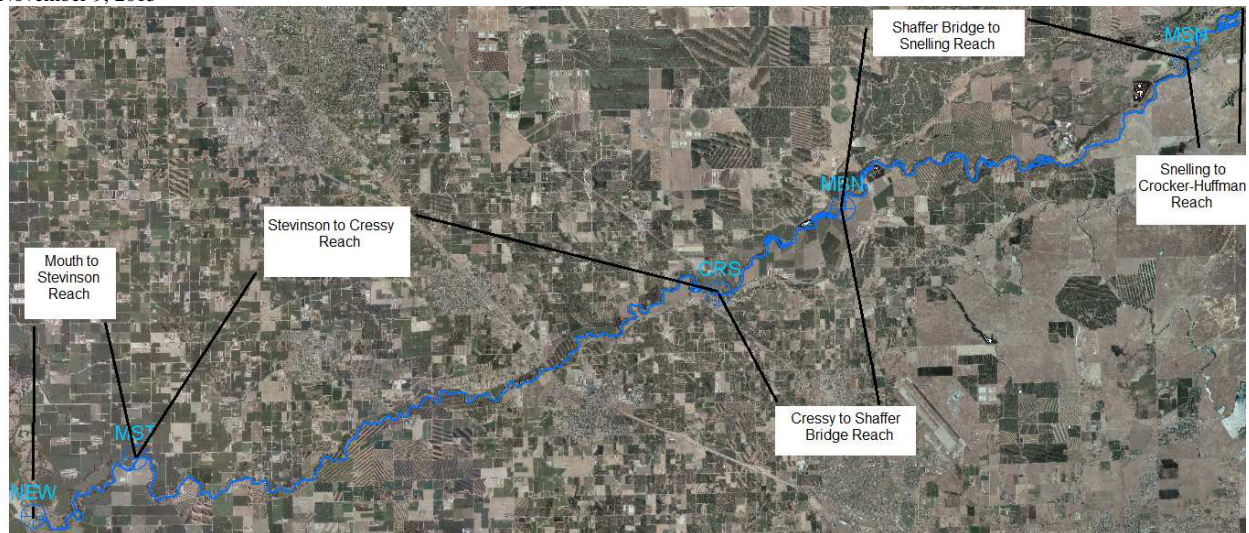


Figure 4
Merced River floodplain modeling reaches

hydraulic model of the mouth of Merced River to Stevinson reach. We used data from pressure transducers that we installed at the mouth of the Merced River in FY 2014, together with stage and flow data from the Newman gage (CDEC Gage NEW), located on the San Joaquin River downstream from the mouth of the Merced River, and Merced River flows, to develop a regression equation to predict the stage at the mouth of the Merced River from the Newman gage rating curve. The stage from the rating tables of the Stevinson (CDEC Gage MST), Cressy (CDEC Gage CRS), Shaffer Bridge (CDEC Gage MBN) and Snelling (CDEC Gage MSN) gages will be used as the downstream boundary conditions for the hydraulic models of the other reaches.

Results

In FY 2015, we were able to collect another week's worth of topographic data during the fall pulse flow. As a result, we now have topography data for 39 of the 52 miles of the Merced River between the mouth and Crocker-Huffman Dam. With limited funding that was available from the Federal Energy Regulatory Commission Program, we were able to complete digital terrains for the lower three reaches and an initial hydraulic model for the lower-most reach. We are currently in the process of an initial hydraulic simulation for the lower-most reach. Completion of our data collection efforts and conducting modeling is dependent on the availability of funding in FY 2016.

South Fork Cottonwood Creek Hammer Dam Post-restoration Monitoring

Methods

The goal of this task was to assess geomorphic changes to South Fork Cottonwood Creek resulting from the removal of Hammer Dam on September 19, 2014. In the summer of 2015, we resurveyed 13 transects downstream of Hammer Dam that we had originally surveyed in the fall of 2013. We also resurveyed a total of 6 transects (three upstream of Hammer Dam and three downstream of Hammer Dam) that were originally surveyed in 2013 by Cascade Stream Solutions. Bed elevation profiles were measured for each transect using standard surveying techniques (differential leveling), and a tape to record stations. We also conducted a pebble count at each of the 6 transects sampled by Cascade Stream Solutions to estimate how the grain size distribution on the creek bed near the monitoring sections changed as a result of removal of Hammer Dam, and took 4 post-restoration photographs (looking from left bank to right bank, looking from right bank to left bank, looking upstream, and looking downstream) of each of Cascade Stream Solutions' 6 transects. A minimum of 75 pebbles⁷ were counted per cross-section. We used the stakeout feature of our RTK GPS equipment to resurvey the longitudinal profile that Cascade Stream Solutions originally surveyed in 2013. The transect data were entered into an Excel spreadsheet to generate bed elevation profiles.

Results

The longitudinal profile (Figure 5) showed substantial erosion upstream of Hammer Dam and some deposition downstream of Hammer Dam. Pebble count data (Table 5) show that there are no longer pronounced differences in the bed material grain size distribution upstream and downstream of the dam. Cross-section profiles and photographs are shown in Appendix A.

Discussion

The post-monitoring data indicates that a 5 to 10 year storm event in December 2014 mobilized a majority of the sediment that had accumulated upstream of Hammer Dam, resulting in a geomorphic condition that no longer shows any effect of Hammer Dam. While there was some limited deposition downstream of the dam site, the channel appears to have returned to a state of dynamic equilibrium.

⁷ While this is less than the standard of 100 pebbles given in Harrelson et al. (1994), it was selected to be consistent with the pre-restoration sampling done by Cascade Stream Solutions.

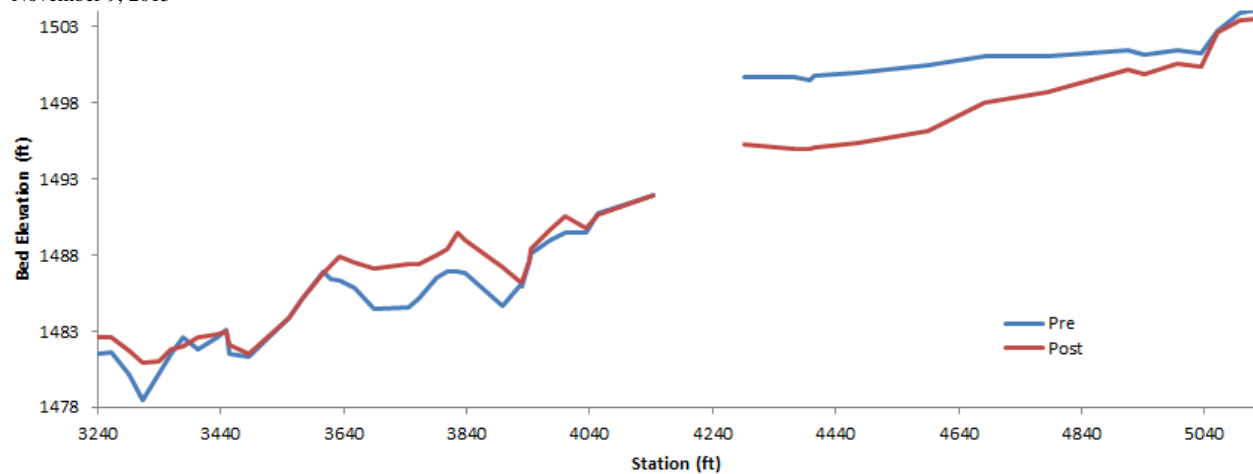


Figure 5
Hammer Dam Longitudinal Profile

Table 5
Hammer Dam Pebble Count Data⁸

Section	D16, inches		D50, inches		D84, inches		D100, inches	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	2	0.6	4.8	5	8.4	14.3	24	24
2	0.4	0.22	1.4	3.5	3	7.1	5.4	24
3	1.3	2.4	3.6	14.3	6	24	9.6	24
4	0.4	1.8	0.7	3.5	1	10.1	3.6	24
5	0.4	1.8	0.1	3.5	0.15	5	0.8	24
6	0.04	1.8	0.1	5	0.2	10.1	0.4	< 14.3

Antelope Creek Lower Slab Upstream Passage Assessment

Methods

The goal of this task was to assess at what flows the Antelope Creek lower slab (Figure 6), also known as Fach's Place crossing, is a barrier to upstream passage of adult spring-run Chinook salmon. A River2D model was developed for the site using the same methods described above for the Feather River. After calibration, the model was run at flows initially ranging from 20 to 85.5 cfs to determine the flow at which the depth on the slab exceeds 0.9 feet for a continuous 3-foot width. The criteria that a total of at least 3 feet of the width must be contiguous for the minimum depth established for the target fish is based on WDFW (2009). The water depth criterion identified for protection of adult Chinook salmon passage is 0.9 ft (R2 Resources 2008). The passage criteria for adults are based upon a literature review conducted by R2 Resources (2008), and are intended to provide protective passage. Ideally, there should be sufficient clearance underneath the fish so that contact with the streambed and abrasion are minimized,

⁸ Sections 1-3 are downstream of Hammer Dam and Sections 4-6 are upstream of Hammer Dam

which R2 Resources (2008) considered to be 0.1 ft. The flow that was determined from the River2D model was compared to historical Antelope Creek gage records to see what percentage of the time during adult spring-run Chinook upstream passage (mid-February to the end of June) Antelope Creek flows exceed the flow from the River2D model.

Results

The initial hydraulic simulations indicated that the maximum depth across the lower slab at the highest simulation flow of 85.5 cfs was 0.5 feet⁹. Accordingly, we continued to run the model at higher and higher flows, until determining that at a flow of 441.5 cfs, the maximum depth across the lower slab finally reached 0.9 feet. Based on flow measurements we made at the site and flow data from the Antelope Creek flow gage (Table 6), the reach between the lower slab and the gage is a losing reach at low flows and a gaining reach at high flows. For high flows, flows at the site are 87% of flows at the Antelope Creek flow gage. Accordingly, a flow of 441.5 cfs at the site corresponds to a flow of 509.7 cfs at the Antelope Creek flow gage. For the period of record for the Antelope Creek flow gage (1940-1982), mean daily flows only exceed 509.7 cfs 5% of the time for mid-February through the end of June.

Discussion

Our ability to develop a stage-discharge relationship for the lower boundary condition for the River2D model was limited by the low flows in FY 2014. As a result, we had to extrapolate our simulations far beyond what we would ordinarily do (2.5 times the highest measured flow). This extrapolation did not affect the results of the hydraulic simulation, since conditions at the slab were not affected by downstream hydraulics due to the two-foot drop of water off the downstream end of the slab. In FY 2016 we will use the hydraulic model to simulate different alternatives to solve the upstream passage barrier at the lower slab.

⁹ The maximum depth was in a side channel portion of the crossing that did not have upstream and downstream conditions, such as a jump pool, that would allow fish to pass. There was a jump pool below the crossing in the main channel, but the jump pool would not allow fish to pass, since the fish would have to jump 11 feet horizontally to get over the shallow conditions on the slab.



Figure 6
Antelope Creek lower slab

Table 6
Antelope Creek flows

Date	Lower Slab Flow	Gage Flow	Percentage of Gage Flow
12/18/2013	34.27	39.56	87%
5/27/2014	30.64	21.18	145%
9/11/2014	22.68	12.98	175%

Sacramento River Juvenile Green Sturgeon Habitat Mapping

Methods

The goal of this task is to support the AFRP funded Juvenile Green Sturgeon Overwintering Migration project by providing in-river physical rearing habitat data prior to juvenile migration to the Delta. These data will be used to conduct habitat suitability analyses for the in-river portion of the juvenile life-history phase, of which little information is known. Future efforts may focus on quantifying available suitable juvenile rearing habitat for green sturgeon within and/or outside the Sacramento River. We mapped the topography, depths and velocities at four sites (Rkm 386, 388, 390 and 394.5) where the Red Bluff Fish and Wildlife Office has captured juvenile green sturgeon. These parameters were mapped using the same methods described above for the Feather River. Each site was sampled once between August 14 and September 30, 2015 at flows ranging from 7,154 to 7,203 cfs. In FY 2016, we will sample one more site (Rkm 370) where the Red Bluff Fish and Wildlife Office has captured juvenile green sturgeon.

Results

The bed topography of the four study sites are shown in Figures 7 to 10, while the depths and velocities at the four study sites are shown in Figures 11 to 18.

Discussion

The next step in this analysis would be to determine the depths and velocities within the subsection of the sites that were actually sampled for juvenile green sturgeon. This subset of depths and velocities would then provide a starting point to quantify microhabitat use requirements for juvenile green sturgeon.

Central Valley Structured Decision Model Evaluation

Methods

We reviewed Peterson et al. (2014) to identify needed changes to the Central Valley structured decision model and sources of data that could be used to improve the parameterization of the model.

Results

Table 7 lists the needed changes to the model that we identified, while Table 8 lists questions about the model. Table 9 lists sources of data that could be used to improve the parameterization of the model.

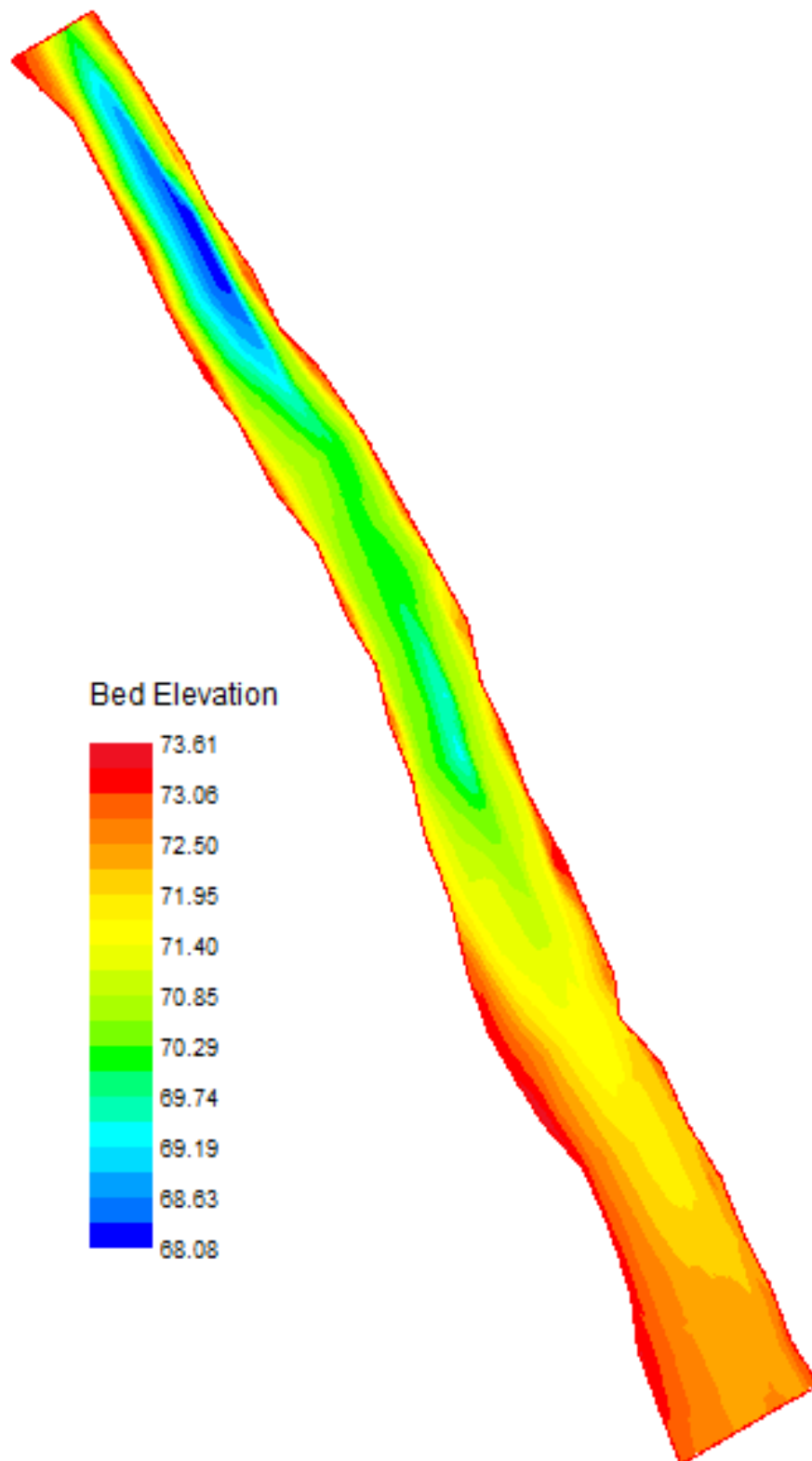


Figure 7
Rkm 394.5 Bed Topography

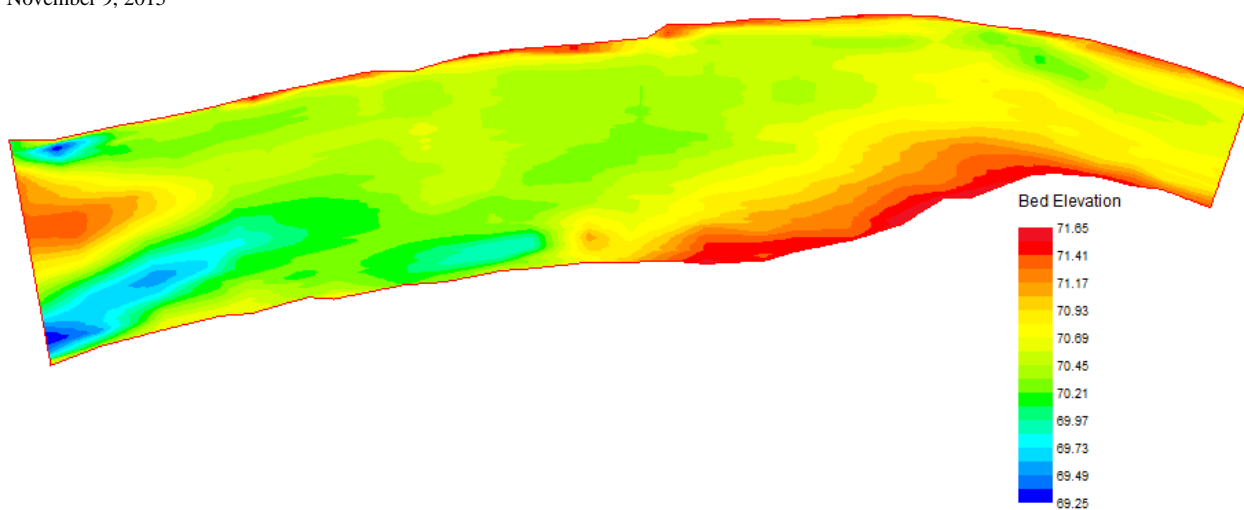


Figure 8
Rkm 390 Bed Topography

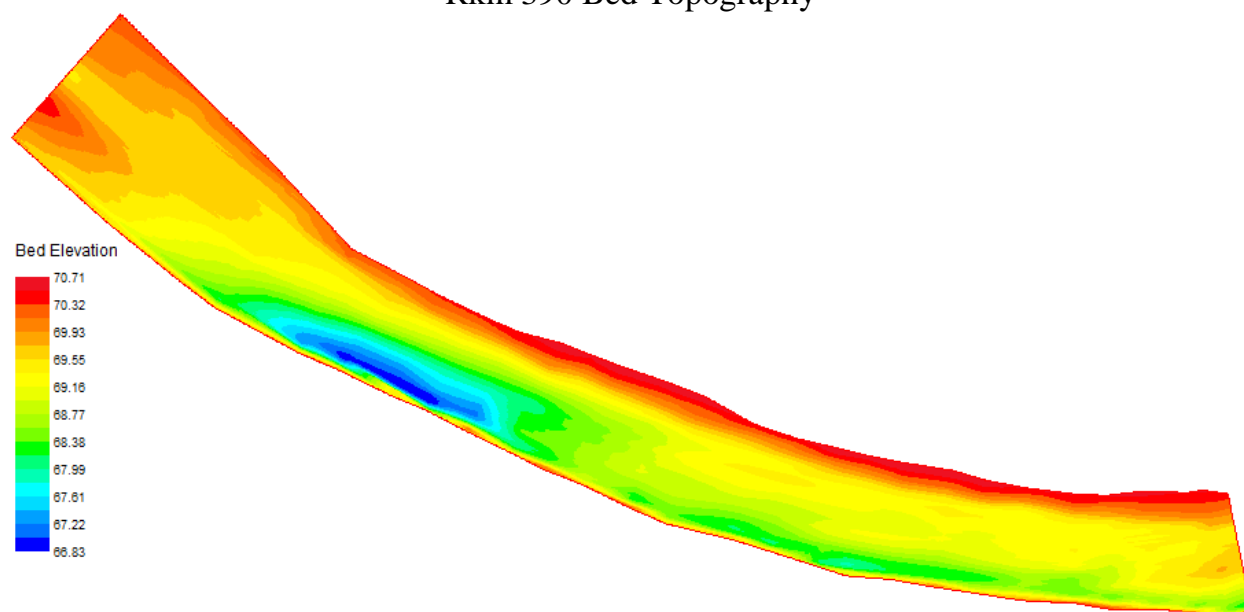


Figure 9
Rkm 388 Bed Topography

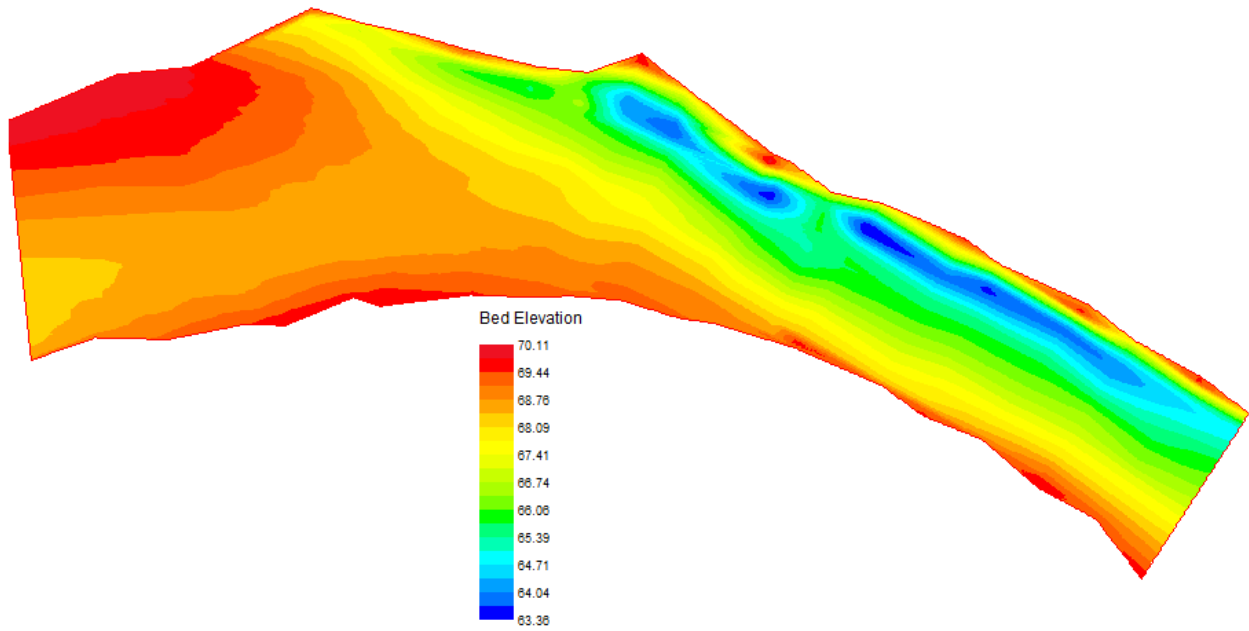


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Rkm 386 Bed Topography

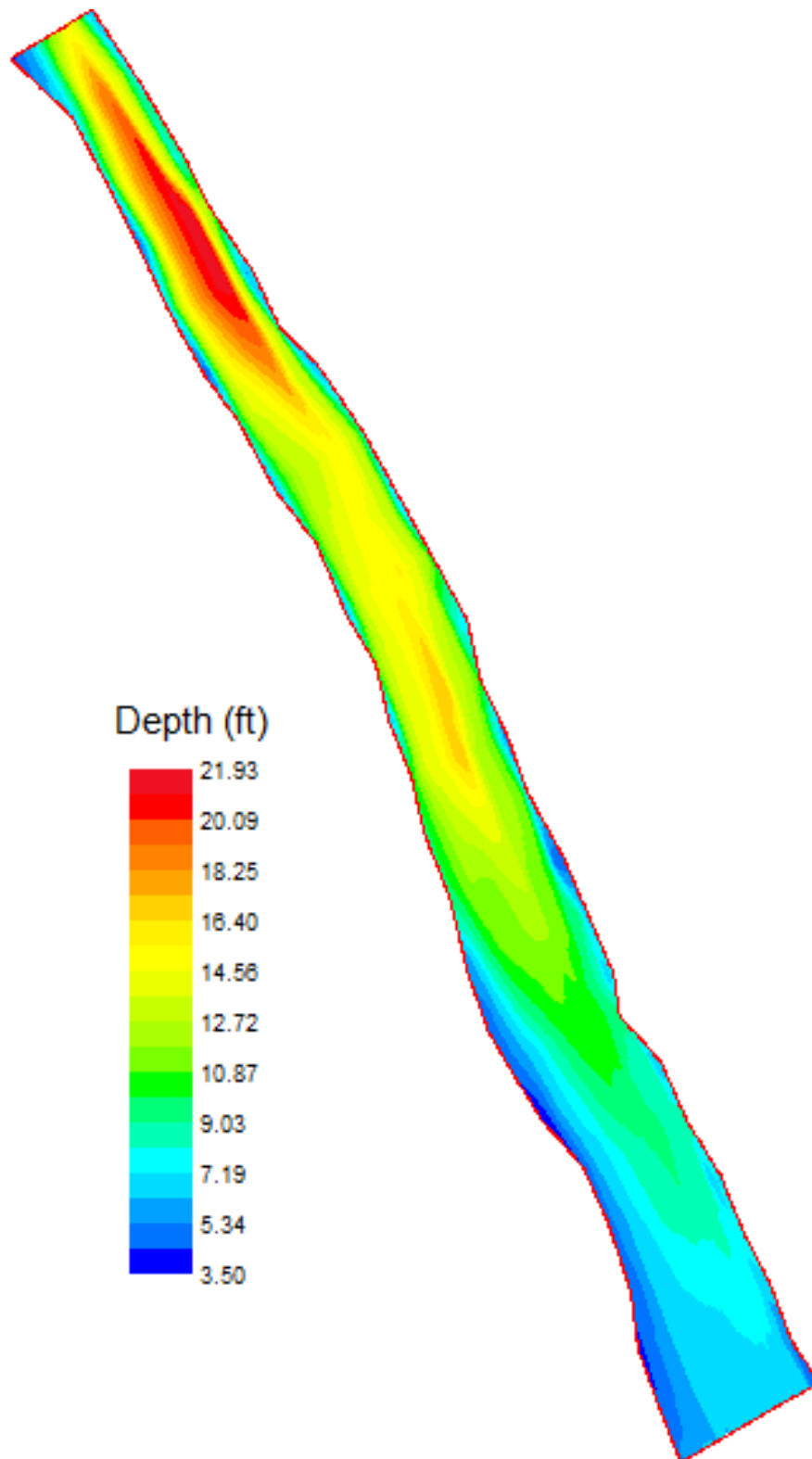


Figure 11
Rkm 394.5 Depths
21

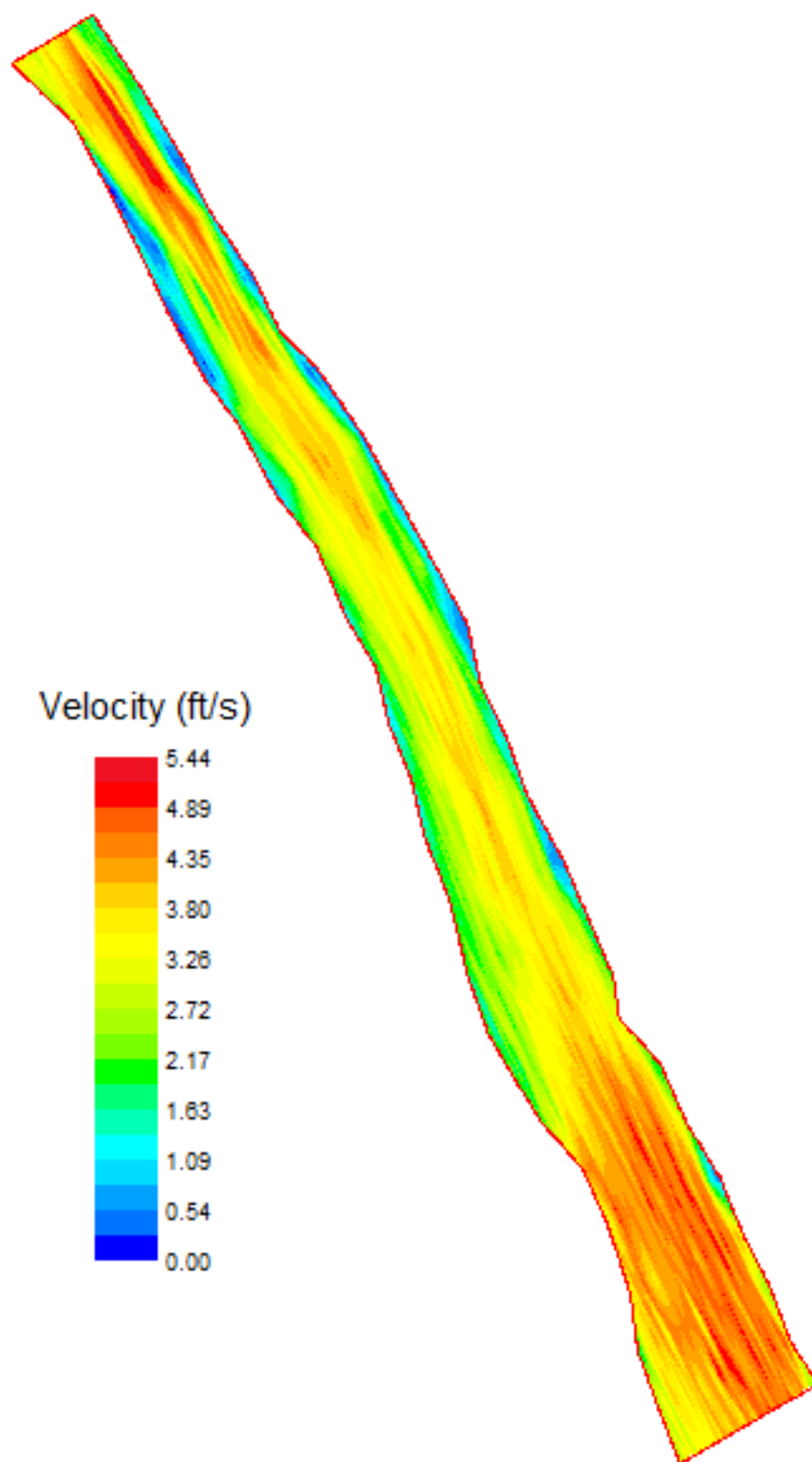


Figure 12
Rkm 394.5 Velocities

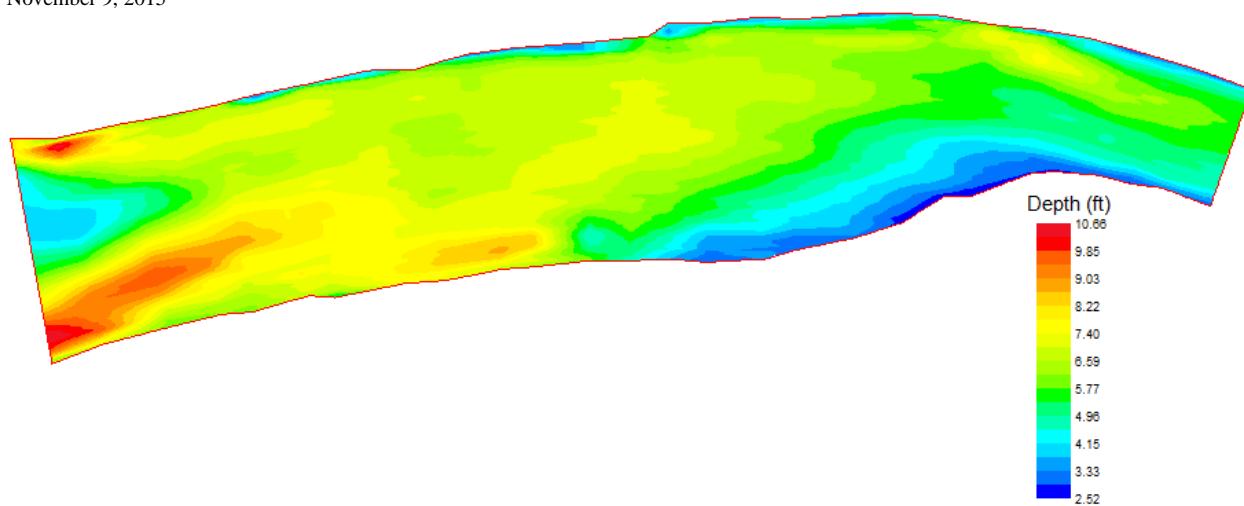


Figure 13
Rkm 390 Depths

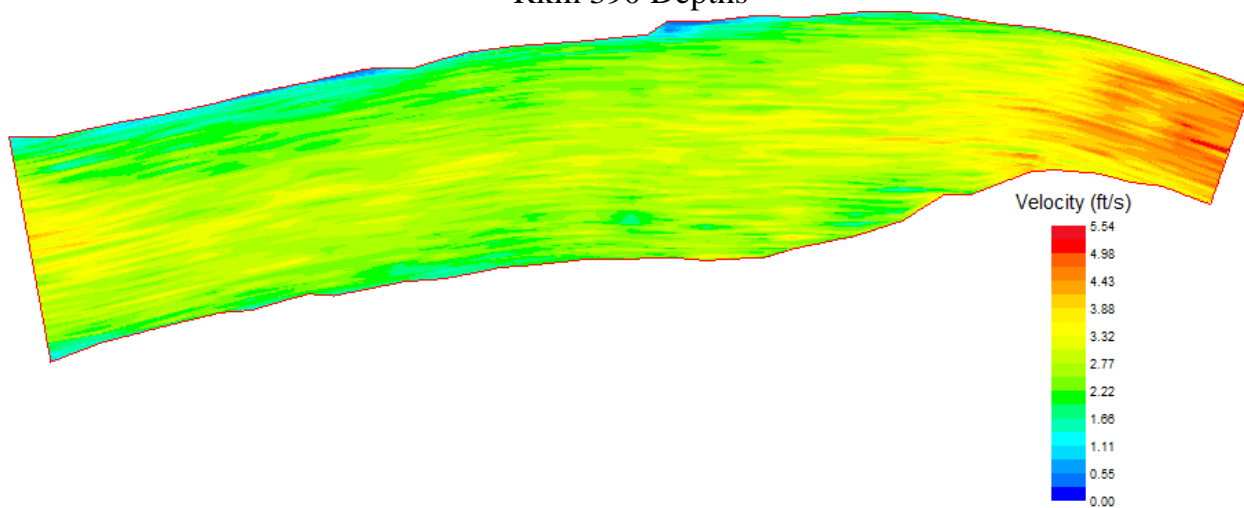


Figure 14
Rkm 390 Velocities

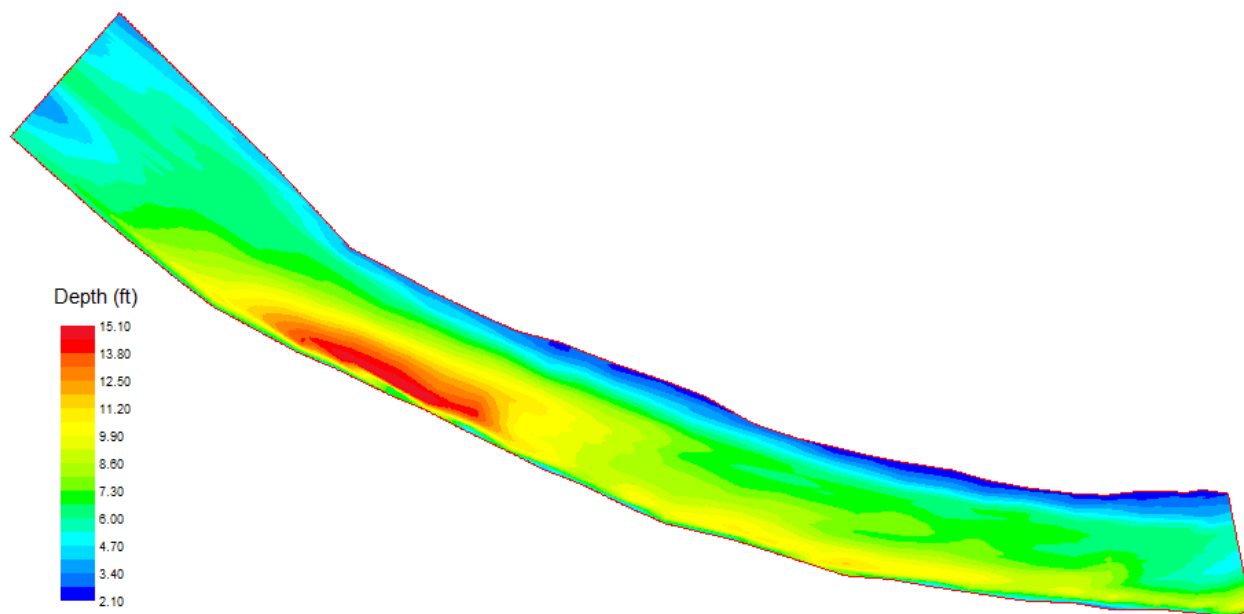


Figure 15
Rkm 388 Depths

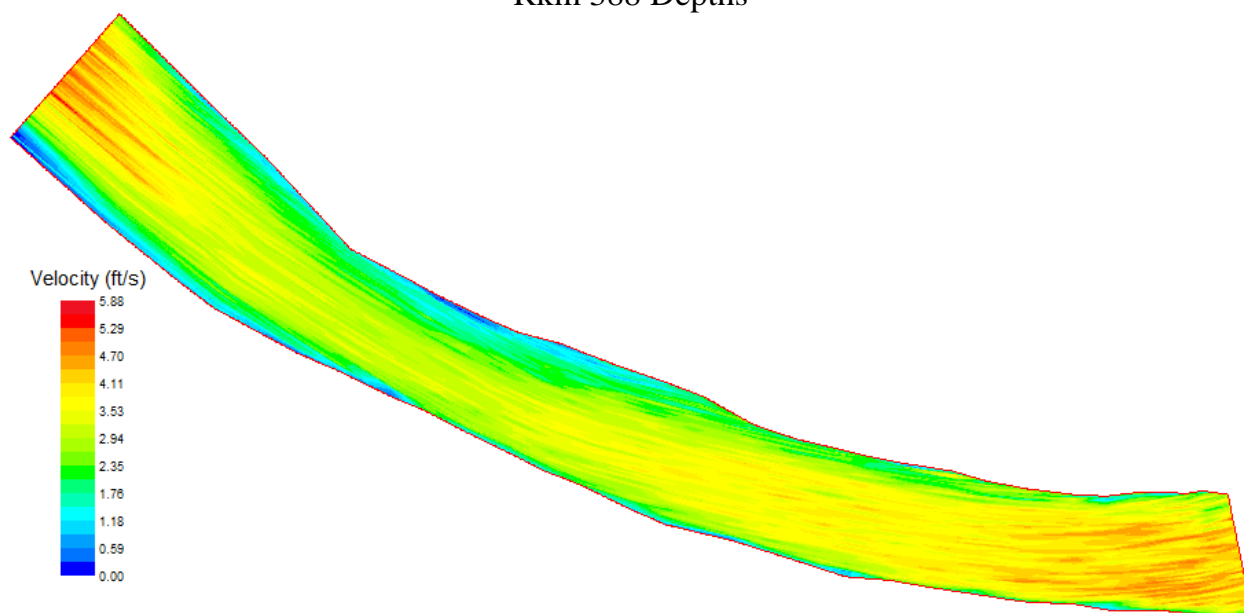


Figure 16
Rkm 388 Velocities

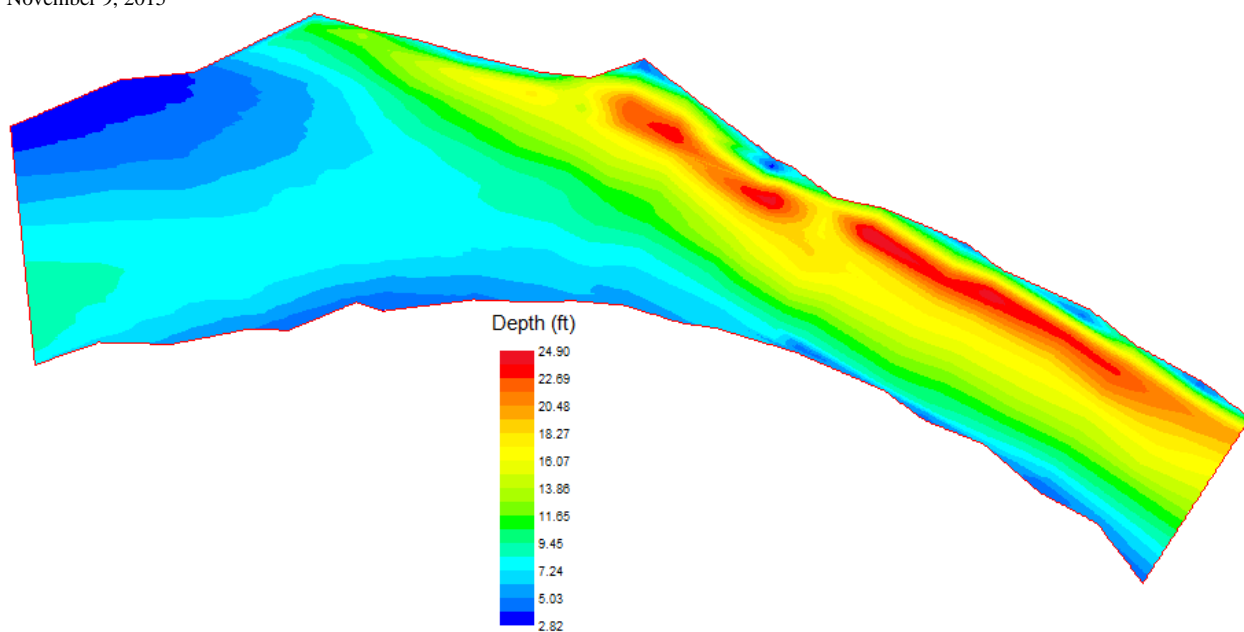


Figure 17
Rkm 386 Depths

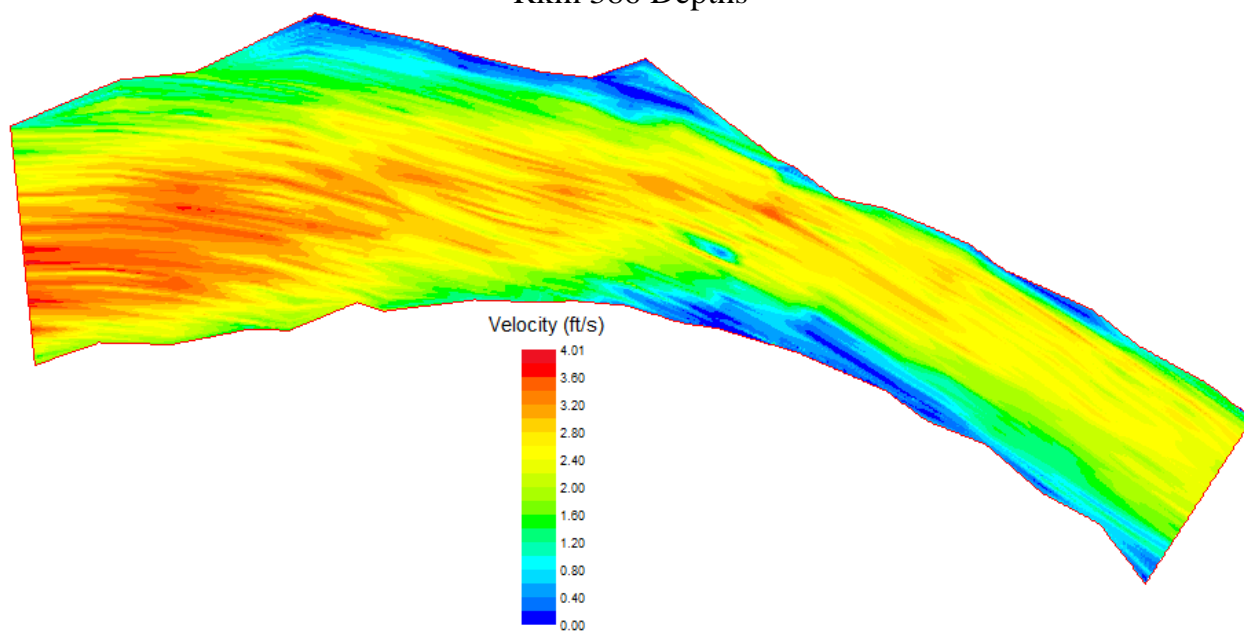


Figure 18
Rkm 386 Velocities

Table 7
Needed Changes to Central Valley Structured Decision Model

Correct Antelope Creek length
Eliminate adult holding habitat for fall-run and late-fall-run
Add differential survival for floodplain versus in-channel habitat based on Stanislaus and Tuolumne data
Change from pools/mile to pool area
Add constraint: proportion of hatchery origin fish less than 20%

Table 8
Questions About Central Valley Structured Decision Model

Does fry/parr/smolt habitat only determine if fish migrate or rear? Doesn't directly affect survival?
How do we evaluate change as a result of actions when size of action isn't large enough to detect a response?

Table 9
Sources of Data to Improve Parameterization of Central Valley Structured Decision Model

Floodplain area data from Newfields
Spawning and juvenile habitat area data from NMFS life cycle model
Update stream length data in GIS based on local knowledge of barrier locations
Generate pool data by mesohabitat mapping in GIS from aerial imagery or from existing mesohabitat mapping data (FWS, FERC relicensing IFIM studies)
Unscreened diversion database from George Edwards (CDFW)
Diversion rates from EWRIMs

Discussion

This information should be useful to the CVPIA fisheries Science Integration Team in their efforts to refine the Central Valley structured decision model.

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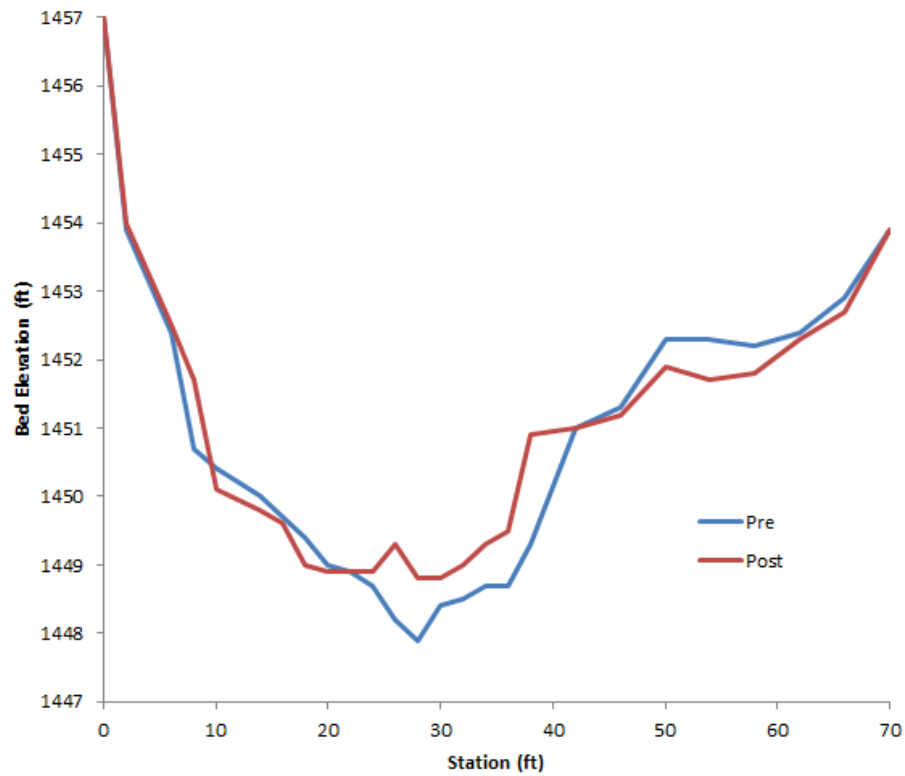
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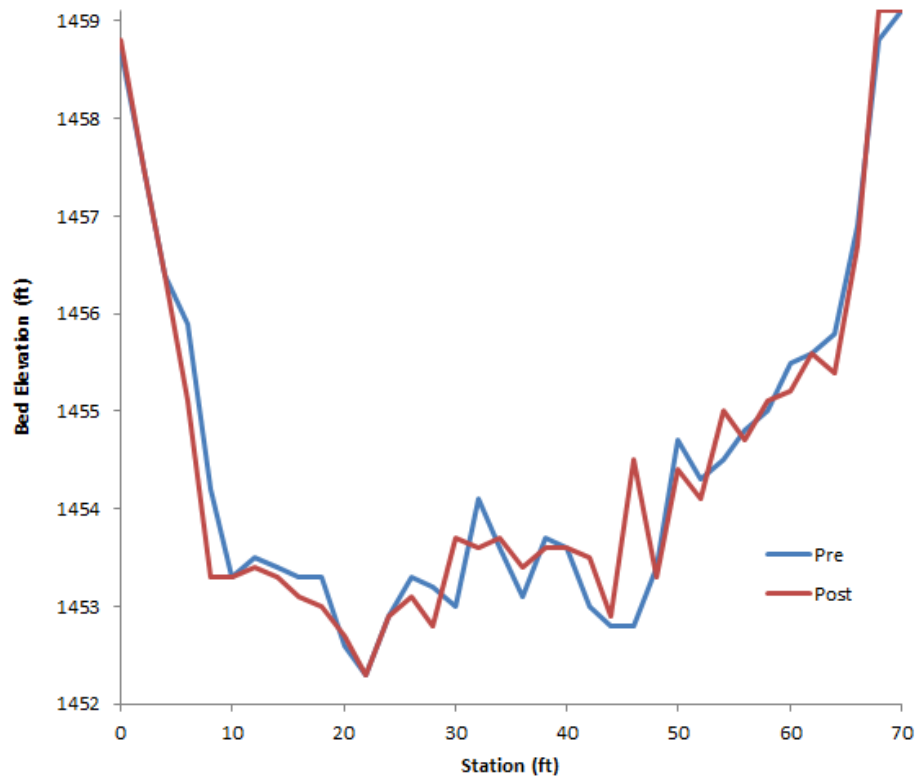
Washington Department of Fish and Wildlife (WDFW). 2009. Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual. Olympia, Washington. 240 pp.

Appendix A

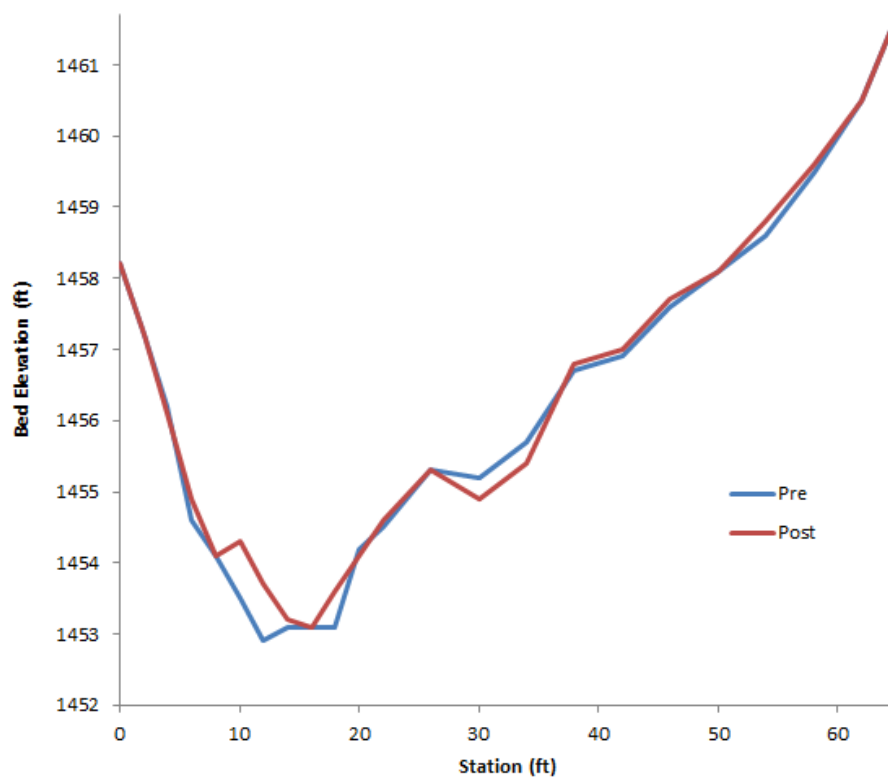
Hammer Dam Cross-sectional Profiles and Photos



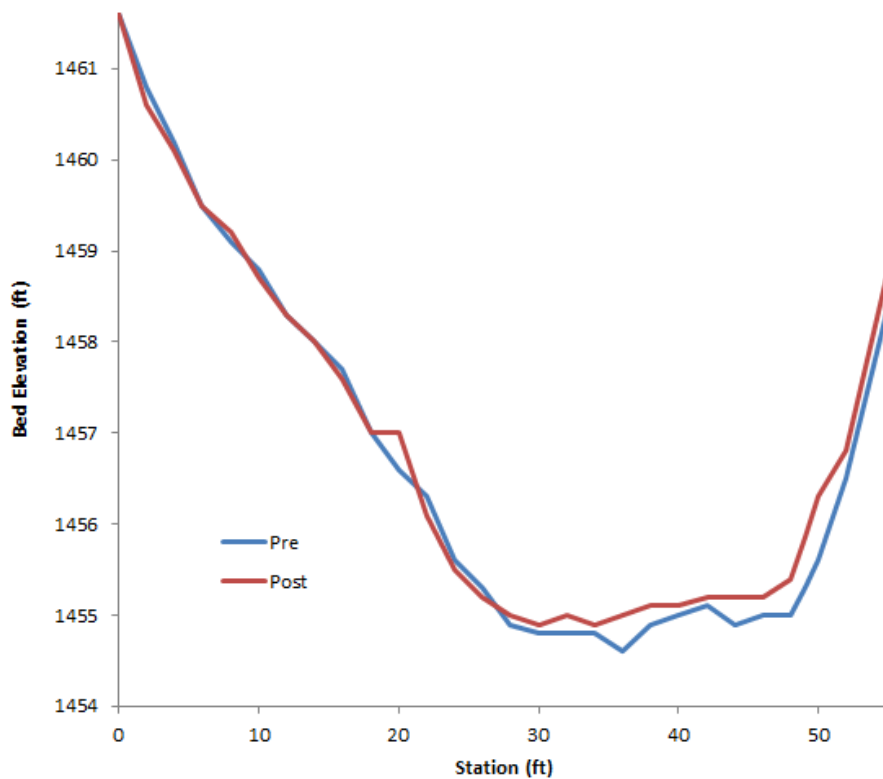
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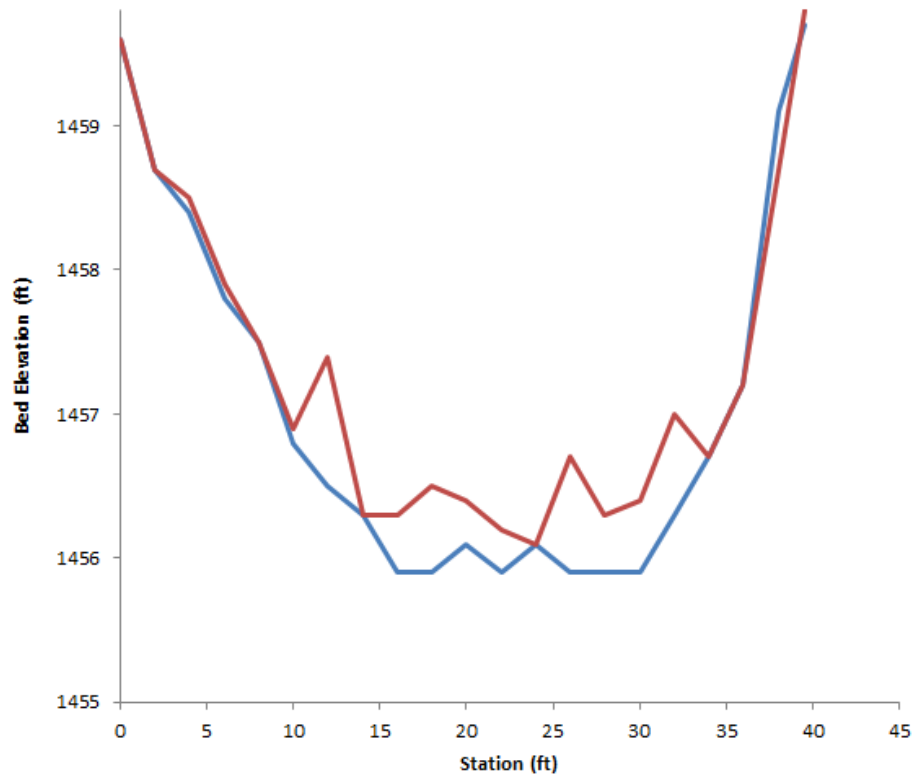
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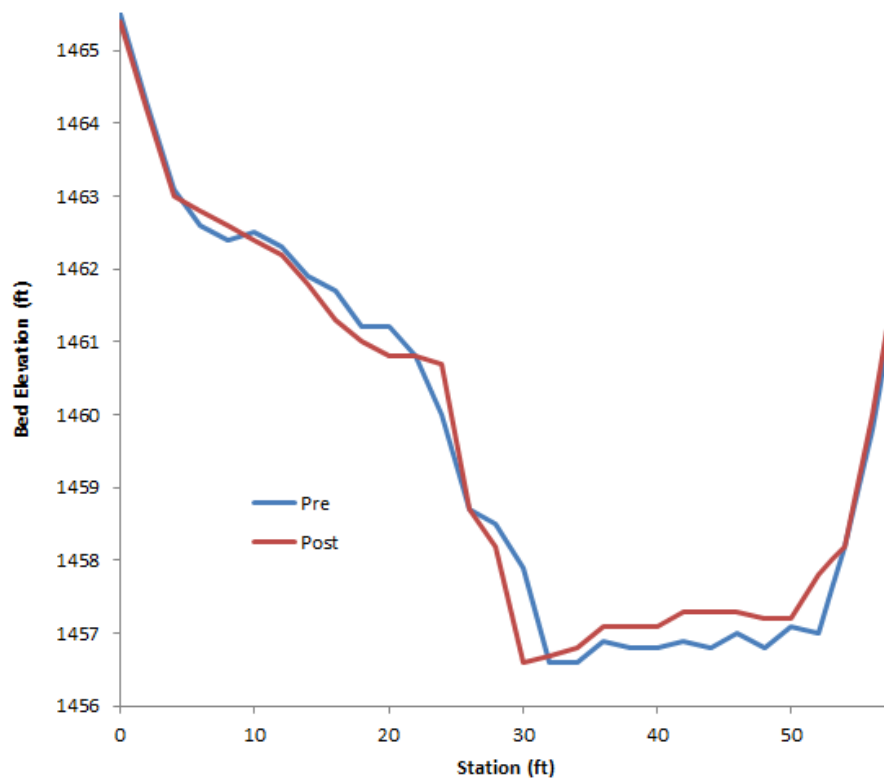
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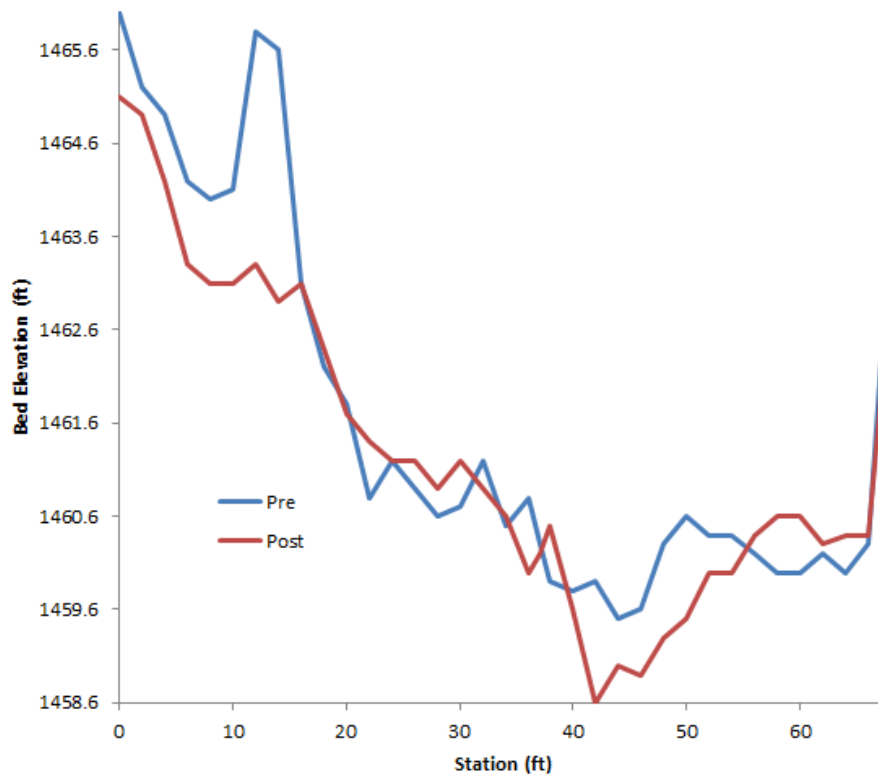
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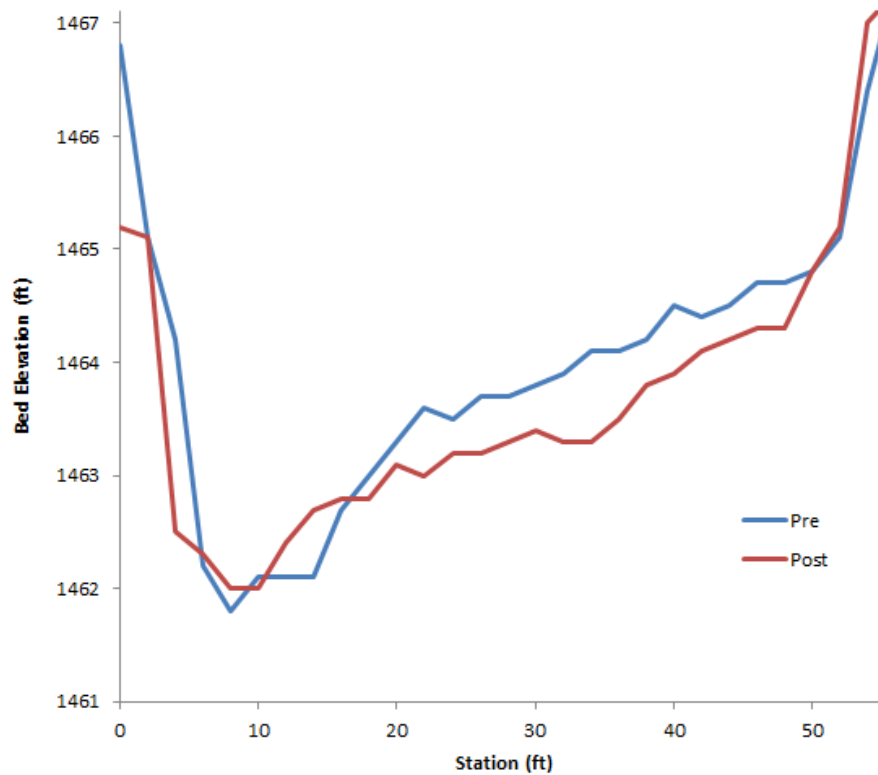
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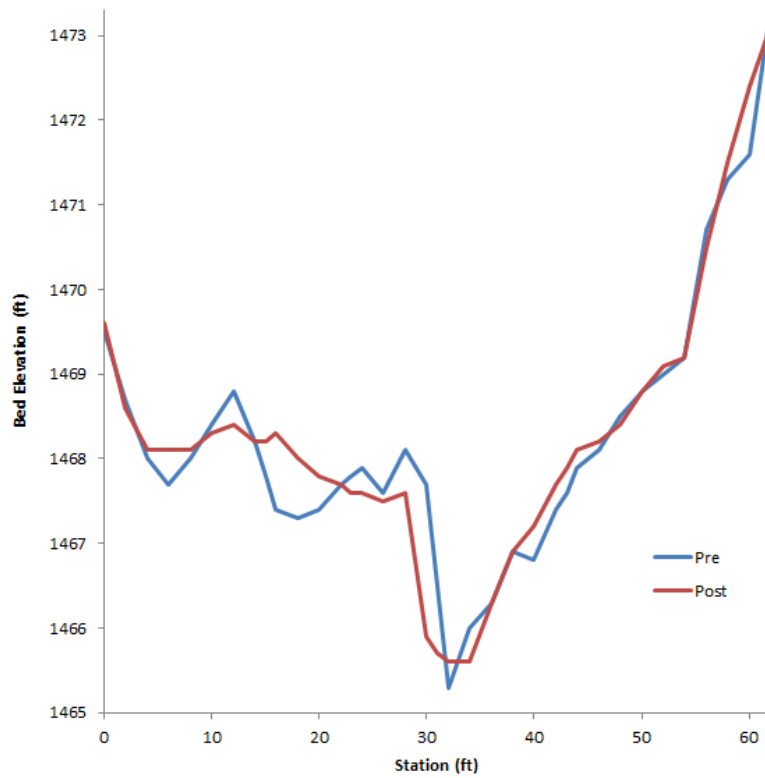
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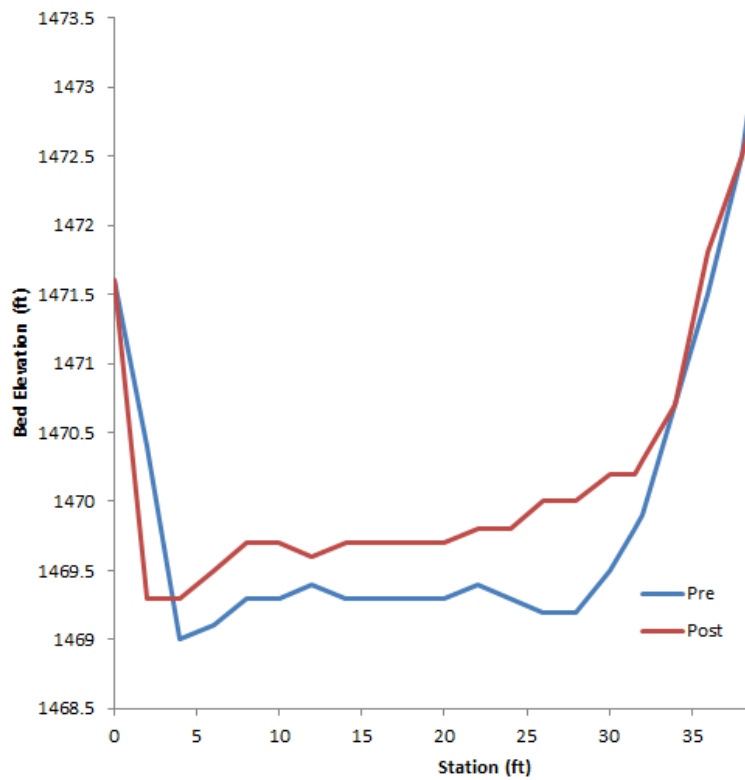
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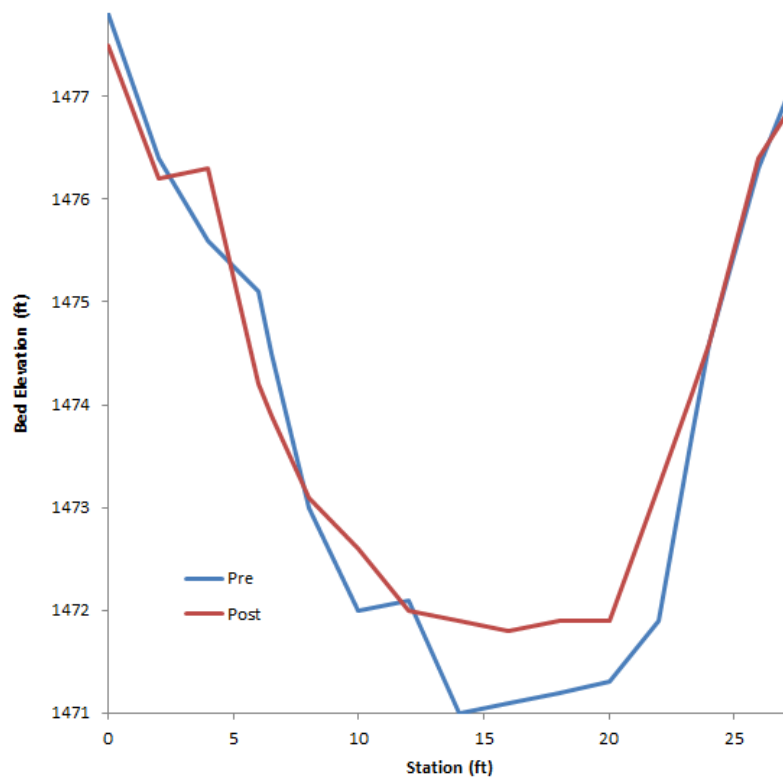
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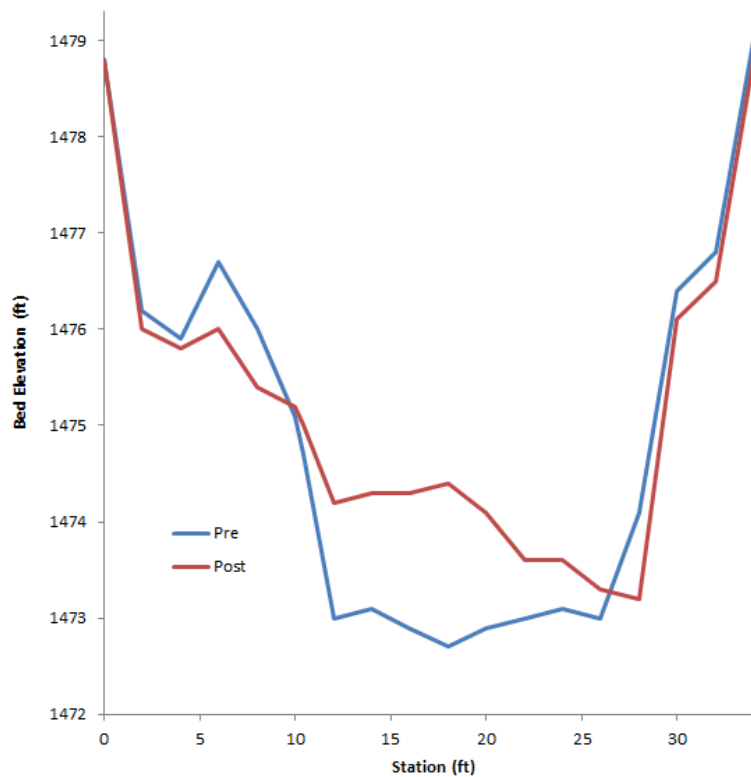
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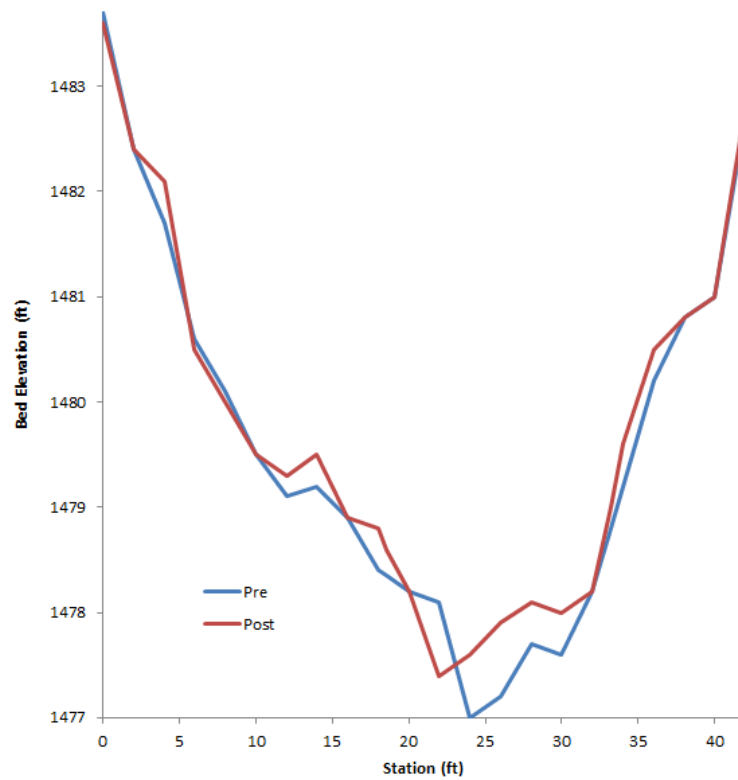
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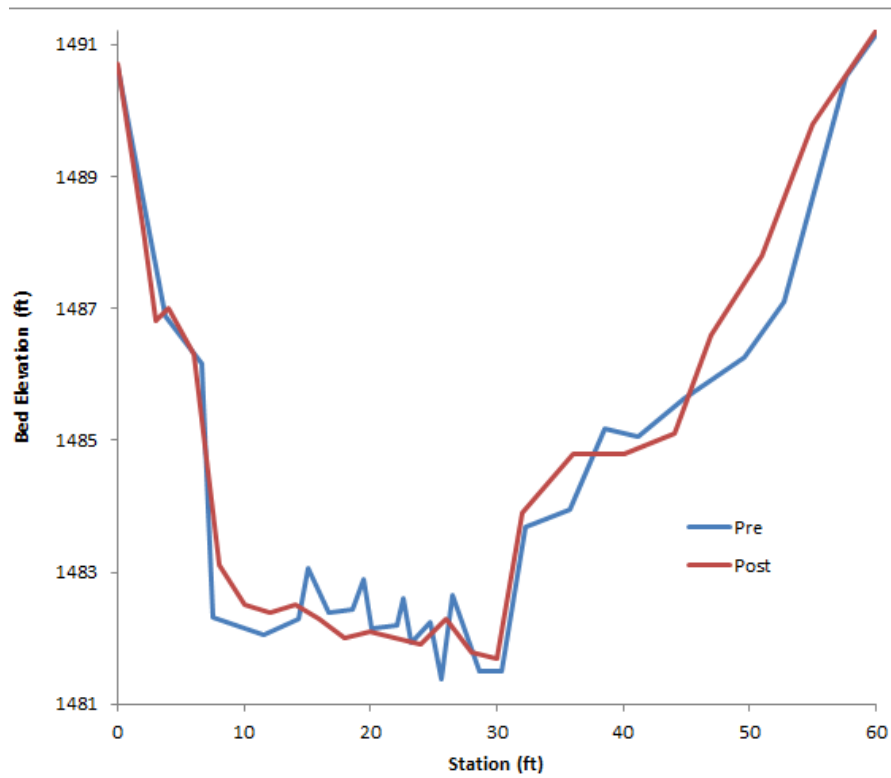
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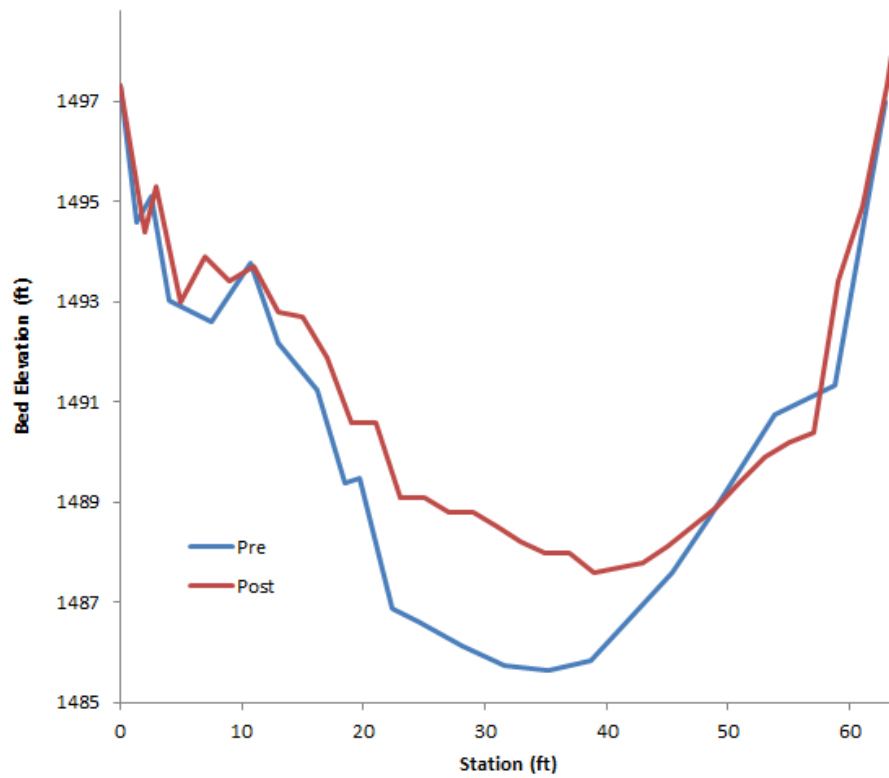
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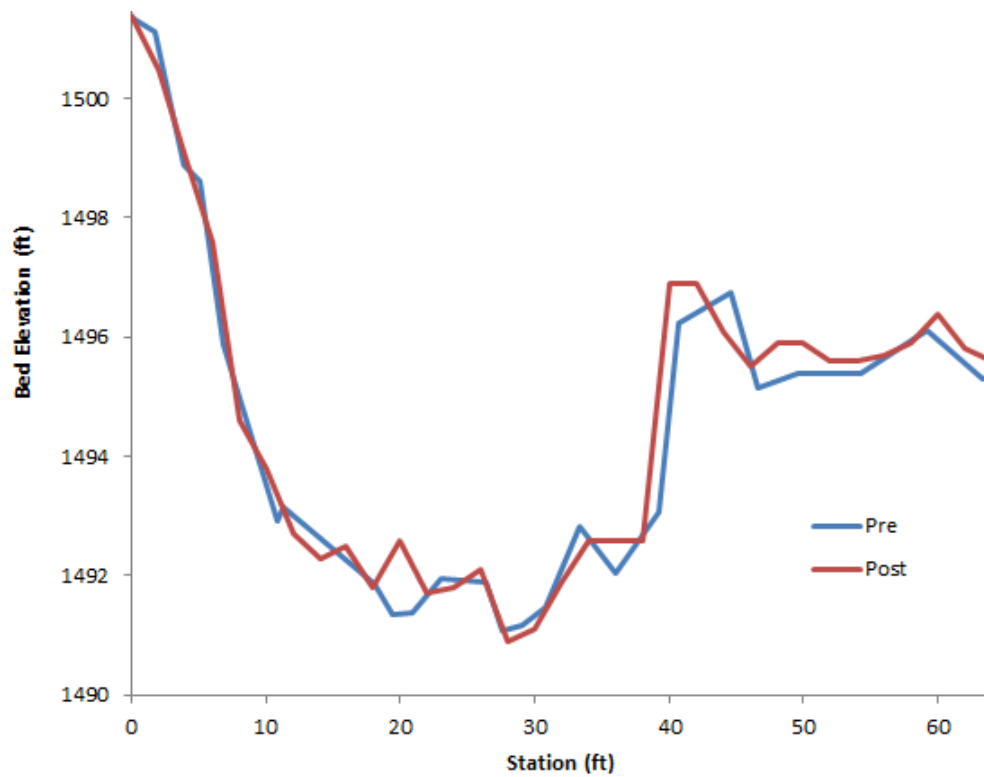
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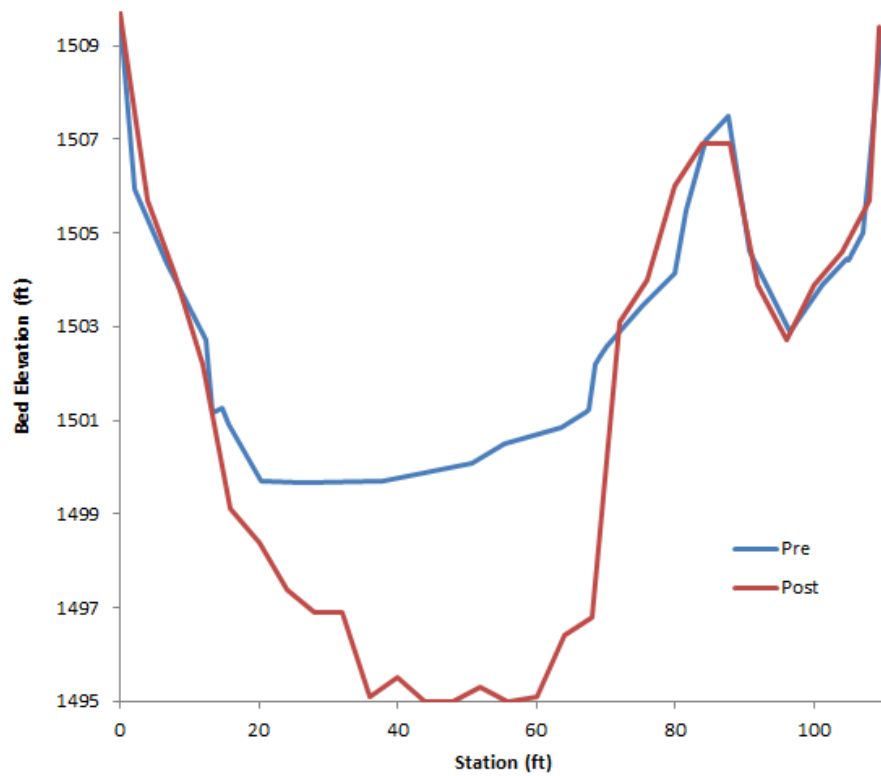
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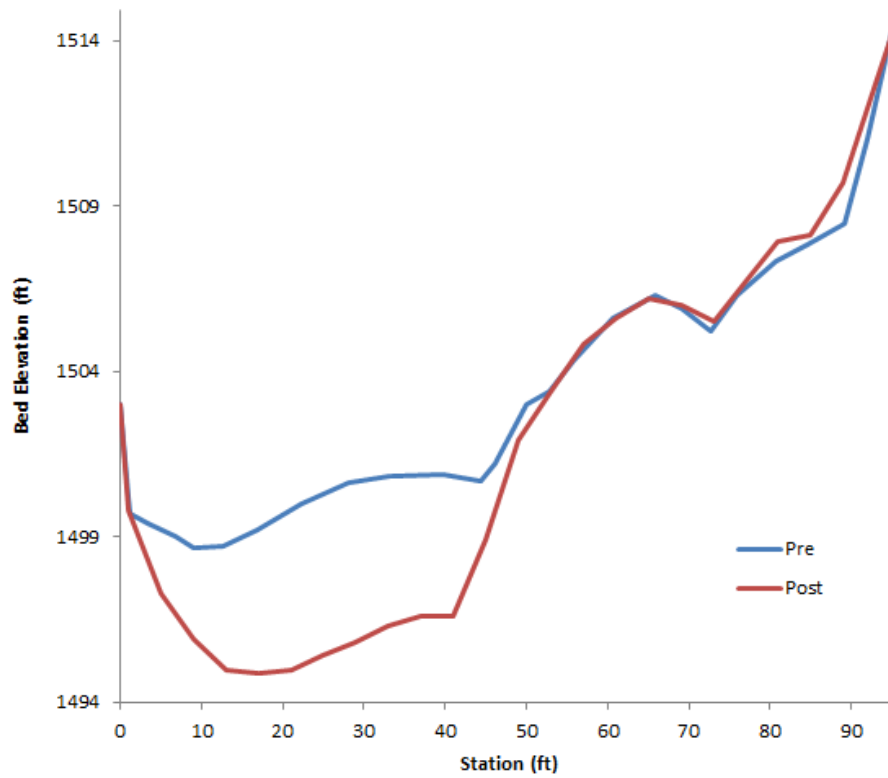
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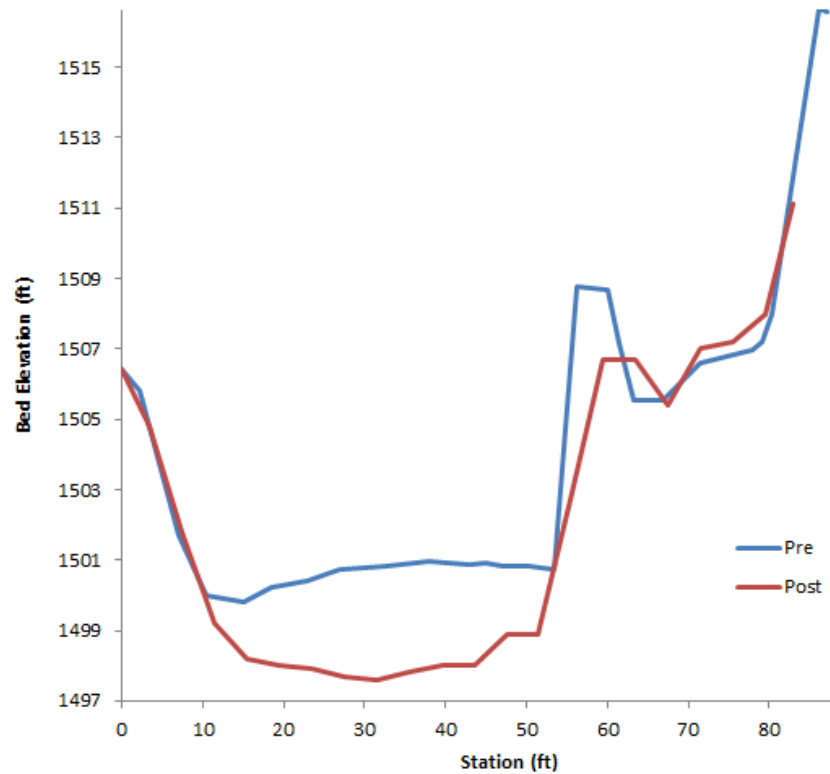
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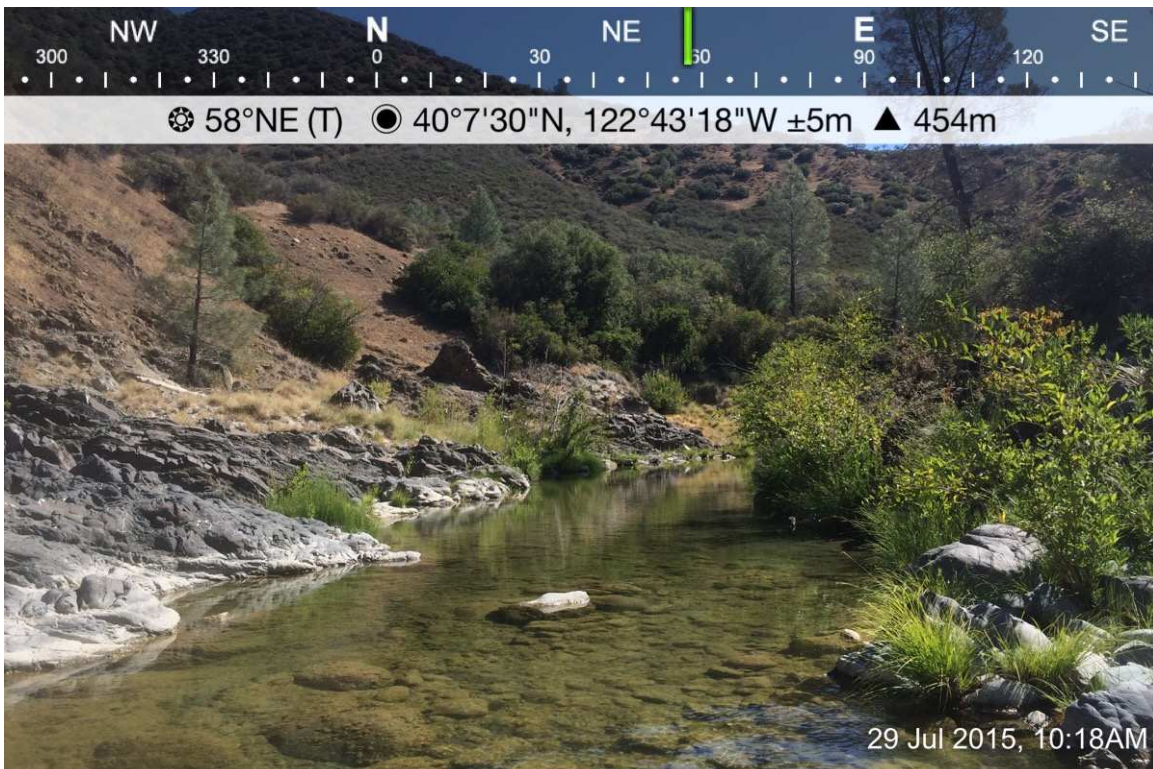
Hammer CSS Section 6



Hammer CSS Section 1 – View of Left Bank from Right Bank



Hammer CSS Section 1 – View of Upstream from Mid-channel



Hammer CSS Section 1 – View of Downstream from Mid-channel



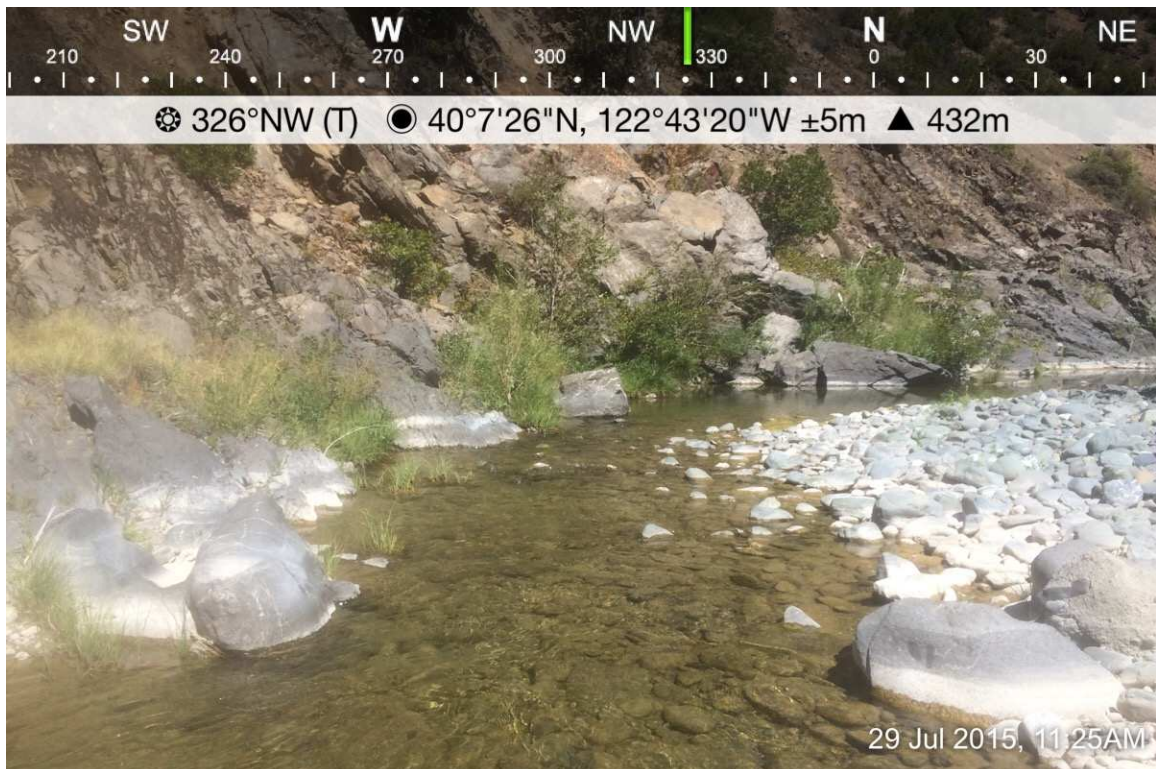
Hammer CSS Section 1 – View of Right Bank from Left Bank



Hammer CSS Section 2 – View of Left Bank from Right Bank



Hammer CSS Section 2 – View of Upstream from Mid-channel



Hammer CSS Section 2 – View of Downstream from Mid-channel



Hammer CSS Section 2 – View of Right Bank from Left Bank



Hammer CSS Section 3 – View of Left Bank from Right Bank



Hammer CSS Section 3 – View of Upstream from Mid-channel



Hammer CSS Section 3 – View of Downstream from Mid-channel



Hammer CSS Section 3 – View of Right Bank from Left Bank



Hammer CSS Section 4 – View of Left Bank from Right Bank



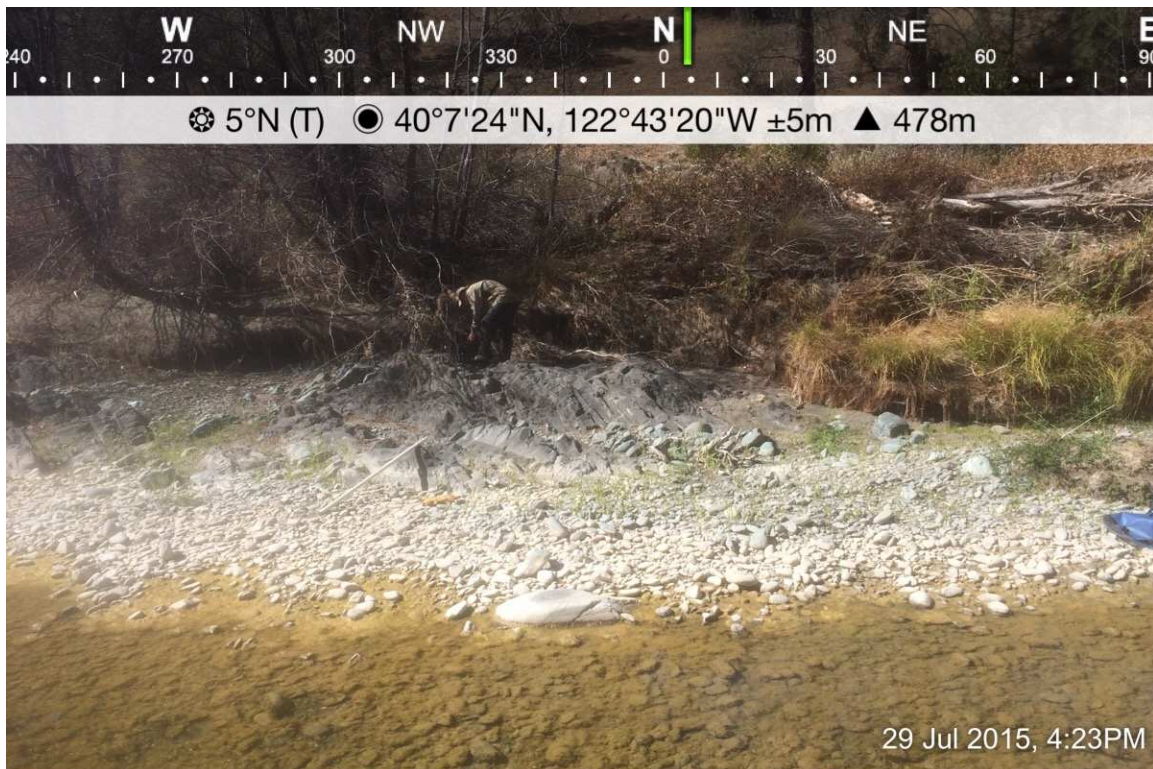
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Hammer CSS Section 4 – View of Downstream from Mid-channel



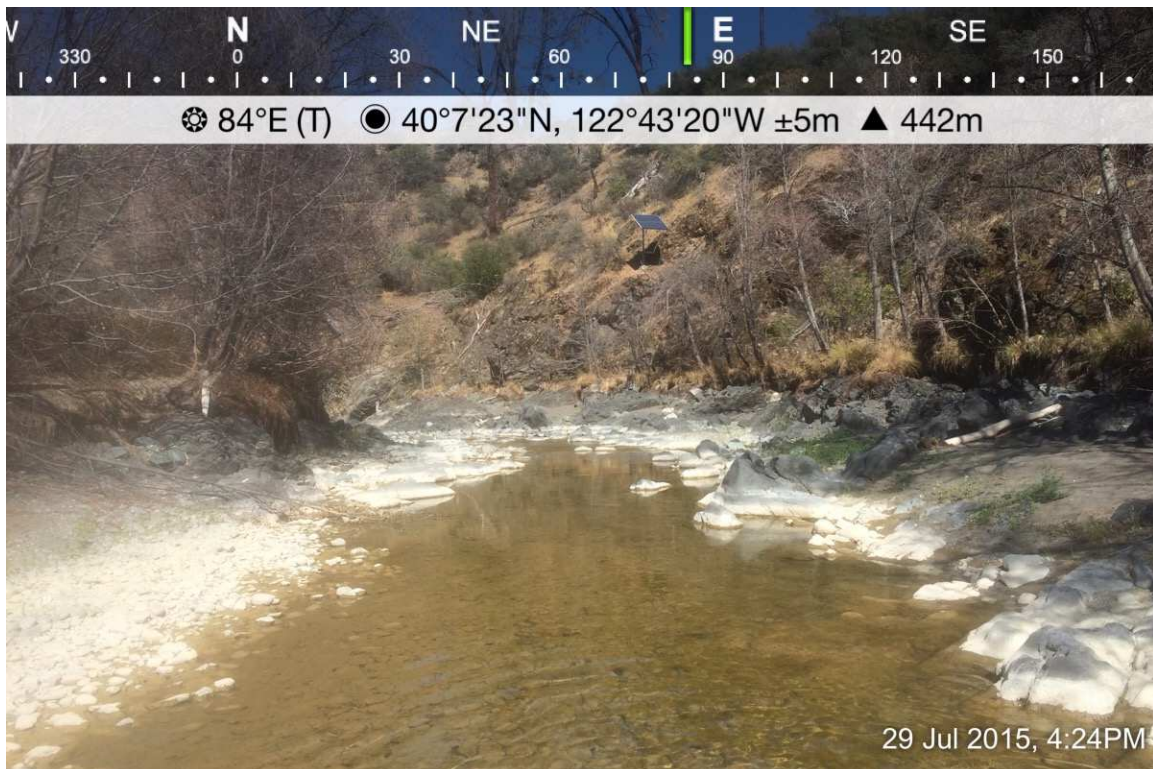
Hammer CSS Section 4 – View of Right Bank from Left Bank



Hammer CSS Section 5 – View of Left Bank from Right Bank



Hammer CSS Section 5 – View of Upstream from Mid-channel



Hammer CSS Section 5 – View of Downstream from Mid-channel



Hammer CSS Section 5 – View of Right Bank from Left Bank



Hammer CSS Section 6 – View of Left Bank from Right Bank



☼ 294°NW (T) ● 40°7'24"N, 122°43'23"W ±5m ▲ 446m



29 Jul 2015, 6:00PM

Hammer CSS Section 6 – View of Upstream from Mid-channel



☼ 102°E (T) ● 40°7'24"N, 122°43'23"W ±5m ▲ 445m



29 Jul 2015, 6:00PM

Hammer CSS Section 6 – View of Downstream from Mid-channel



Hammer CSS Section 6 – View of Right Bank from Left Bank